THE PSYCHOLOGY
OF
HUMAN BEHAVIOR

THE PSYCHOLOGY OF HUMAN BEHAVIOR

BY

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TO

MY TEACHERS

J. H. FARLEY

A. A. TREVER

Masters of Socratic maieutics

PREFACE

In plan and contents the present book reflects the experience gained from a dozen years of teaching elementary psychology to college students. A significant part of this experience comprises the reactions of students both to the study of psychology itself and to different ways of presenting the science. These reactions, to the instructor who is and remains sensitive to them, furnish an invaluable check-up on the effectiveness of methods of presentation.

Accordingly, the order and selection of topics follow from the author's observations that students, by and large, wish to discover at the outset what psychology is, how it came to be a science, who some of the more important men of the science are, and what psychology has to offer as a curricular study. Since, for most students, psychology is a brand-new subject, their initiation into it preferably takes the form not of plunging them *in medias res* but of orienting them in terms of its origin and development.

Following the orientation, the book introduces the topic of learning—a topic which, in the author's experience, induces in the students a positive realization of the direct significance of psychology for their own immediate problems. Pedagogically, this procedure is sound. For unless the students come to this realization quite early in the course, they are apt to regard the study as having no vital significance for them. Some teachers, however, may find it feasible to introduce a different topic. If so, one will find the order of topics quite susceptible to rearrangement without incurring confusion on the part of

the students. After all, as a perusal of the more recent texts will reveal, there is no sacrosanct sequence of topics. In psychology, as in numerous other fields, the pedagogically important thing is not so much the particular route as the competency of the guide.

This text aims to present psychology as a vital human interest in itself and as a basic equipment for various professional interests, but withal from a strictly scientific viewpoint. Doubtless, one should not draw a sharp line between the "pure" and the "applied." Even in science one should endeavor to see life whole. Hence a scientific program should involve *somehow* the intent to illuminate the problems of life and thus to contribute to the achievement of successful living.

The book is highly adaptable as the basic text for a one-semester course or longer. In any event, assignments of laboratory exercises here and there should greatly promote understanding of numerous aspects of the science. Supplementary readings are suggested at the end of each chapter. These are intentionally catholic in range; hence are adaptable to different levels of comprehension and interest. By judicious selection of these readings each student should gain not only a greater working knowledge of psychology in its more practical bearings but also an increasing depth and range of insight into psychology as a science. Students of above average intellectual keenness should be encouraged to dip into the source materials indicated in the references for each chapter.

In preparing the manuscript for publication the author has sought counsel from many sources. Not the least in importance have been the suggestions from students who, having used as a text the original draft in mimeograph form, pointed out with admirable frankness its defects as well as its merits. Several colleagues also read the original draft and have contributed invaluable criticisms throughout. These colleagues, representing varied

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Particular acknowledgment should be made of the inspiration and encouragement imparted by Professor Warren Beck. For his keen interest and generous expenditure of time and energy in criticising the manuscript throughout its composition the author owes an incalculable debt of gratitude. Whatever excellence the book may manifest is in no small measure attributable to him.

J. H. G.

Appleton, Wisconsin,
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PART I

WHAT PSYCHOLOGY IS

CHAPTER I

PSYCHOLOGY'S ORIGIN AND DEVELOPMENT

Everyone who seeks knowledge of human nature is already, in a sense, a psychologist. Hardly a day goes by without our passing judgment upon our own behavior and upon that of our fellows. And when to these judgments one attaches explanations, one is actually *psychologizing.*

Indeed, one cannot avoid being a psychologist for the simple reason that one's social training from childhood on has to a large degree consisted of information about human nature; information which one constantly uses for purposes of understanding one's fellows, of gaining advantage over them, thereby aiming to improve one's own personal and social status. Much of this information may not be scientifically accurate. If it were accurate, one would not need to pursue a course in the science of psychology. But a little reflection will suggest that many of our interpretations of human nature are couched in terms and reveal viewpoints whose claims to acceptance rest more often upon traditional usage than upon scientific validity.

For example, in expressing the opinion that John Smith has a melancholy disposition or that Mary Jones is a sanguine person, one is actually using terms whose origins lie deep in antiquity. "Melancholy" pertains to "black bile," "sanguine," to the blood; both terms signify the ancient belief that personality traits are ascribable to physiological processes. In truth, the very language forms by which we do our everyday thinking

are surcharged with primitive conceptions of natural phenomena as well as of human personality. One needs but to recall that popular speech still employs expressions like the "four corners" of the earth, the "rising and setting" of the sun, "thunderbolts," "fiery tempers," "full of the devil," "learn by heart," and many others.

Of course, on second thought, one readily acknowledges such expressions to be instances of poetic license and traditional belief. However, one must not be unmindful of an ever-present human tendency to use similarly outmoded expressions as though they actually portrayed nature and human nature. To recognize this tendency at the very outset of the present study will help to clarify our perspective of psychology as the *science of behavior,* and will orient us towards a sounder basis for our psychologizing than traditional notions can afford.

PSYCHOLOGY'S BIRTH IN GREEK PHILOSOPHY

One may refer to the birth of a science in only a relative sense. Historically it is often exceedingly difficult to locate a beginning for the obvious reason that the farther back one goes the more scanty and obscure one finds the literary records. A number of the sciences trace their ancestry to Aristotle (384-322 B.C.) only because he is reputed to be the original definer and classifier of these sciences. But traces of these sciences are discoverable in writings which antedate Aristotle by some centuries. Aristotle, at all events, seems to have written the first extended treatise upon psychology.

The original meaning of psychology.—The name "psychology" is itself made up of two Greek words: *psyche,* meaning soul, and *logos,* meaning study. One discovers that the ancient Greeks were interested in human nature as a subject for investigation and one would judge therefore that they had arrived at some

conclusions respecting this nature. Indeed, their writings indicate that the Greeks shared a belief in the existence of souls which they thought of as inhabiting or as animating human bodies. Some of the writers, notably Plato, believed the soul to be capable of existing independently of the body. Other writers, notably Aristotle, interpreted the soul to be the *life* of the body in somewhat the sense that seeing is the activity of the eye.

Human nature as body and soul.—Psychology thus emerges as a particular interest among the philosophers of ancient Greece. But these men did not invent the idea of the soul, nor were they the first to conceive human nature as a duality of body and soul. As far as we know, they took over the idea rather unquestioningly from the current beliefs as reflected in folklore, religious sentiments, and in common observations. True, these men developed varying interpretations of the nature of the soul in its relation to the body; but that the soul really existed seems not to have been doubted.

And if, beyond the Greek philosophers, we penetrate as far into primitive thinking as we can, we find the duality of human nature apparently invariably taken for granted. From their languages one observes how various ancient peoples identified the soul as something vaporous and evanescent. One repeatedly discovers similarities in usage of the same word for breath and soul. The Greek word *psyche,* noted above, the Hebrew *ruah,* the Chinese *shen,* the Latin *anima* and *spiritus,* and the old English *gost*—all denote soul, life, and breath. Likewise the Sanscrit *atman,* which is akin to the Greek *atmos* (*cf.,* the English word "atmosphere"), indicates breath and soul. And in all these instances soul is not only contrasted with body but is regarded as having a separable and more exalted nature.

Where mind comes in.—Besides *psyche* the Greeks had another word *nous*, which they used much as we use the word *reason*. It is usually translated "mind" inasmuch as it signifies the intellectual aspect of the soul, an aspect which the Greeks viewed as immortal and divine and therefore superior in nature to those other aspects called the emotional and vegetative. The distinction here implied persisted for many centuries, taking the form of an antithesis between "rational soul" and "sensitive soul." Eventually, however, mind and soul became synonymous terms, though not without confusion.[1]

THE MEDIEVAL-RENAISSANCE DEVELOPMENT

Arising as it did from primitive religious notions of a soul and fashioned upon the touchstone of Greek philosophical reflection, psychology was destined for a long time to have its character shaped by theology and philosophy.

Human nature as a theological interest.—It is well known that, following the Greek epoch, the establishment of Christianity as the official religion of western civilization and the consequent rise of a powerful Church led to the domination by the clergy of whatever learning there was. Up to the period of the Middle Ages no investigations of any scientific sort were possible, inasmuch as the Church fathers guided all education in channels of dogma derived from biblical authority and revelation. Certainly there was not even a semblance of a psychological study of human nature; nothing but theological doctrines about the creation of man's soul, his fall, his redemption, and about the Church's responsibility in regulating man's conduct to the end of saving his soul.

But it so happened that after centuries of obscurity

[1] *The Oxford Dictionary* (1933) still defines psychology as "the science of the Nature and Functions of the Human Soul or Mind."

the writings of the Greek philosophers, particularly Aristotle, came to light and began to infiltrate medieval thought. However, since the interpretation of human nature had already been fixed by dogma, the teachings of the Greeks had to be molded to accord with the doctrines of the Church. For the Church fathers contended that philosophy comes after theology; and they argued the superiority of the latter to the former on the basis of faith in divine revelation. Wherefore we get the famous medieval assertions: Faith is prior to reason; reason may be used to support faith, but where reason conflicts with faith the latter must retain supremacy.

Throughout the Middle Ages, consequently, the psychologizing of men like Plato and Aristotle mingled with the dogmatizing of the Church, the result consisting of abstruse elaborations upon the nature of soul-substance. For example, we find the medieval philosophers arguing to the immortality of the soul from its nature as "immateriality" which, though connected with a material body, is not dependent upon the body but is derived from the divine soul. Writings supposedly psychological were wholly concerned with statements of the relations of the soul to the bodily senses, to feeling, to intellect, and to will, and the relations of these in turn to the attributes of the divine soul. There was no appeal to factual data of an experimental sort. Indeed, the medievalist could hardly conceive the possibility of experimentation as a method for dealing with the problems of human nature. In any case, the Church could sanction no freedom of inquiry because it felt that its own divine revelation was final.

But policies of restricting human inquiry never maintain themselves permanently. Seeds of intellectual curiosity find germination and fructification somewhere. Despite taboos and finalities of judgment, individuals

appear whose critical insights lead them to challenge the validity of established claims. Not that any one critic can disentangle himself completely from the intellectual deposits of his age; he always bears traces of his origins. Yet every age produces thinkers whose claim to fame and value to posterity lie in their having freed themselves from the shackles of orthodox belief, thus pointing a way to intellectual progress. Such names as Roger Bacon, Giordano Bruno, Copernicus, Galileo, and Harvey loom up as veritable landmarks of intellectual history. And although we esteem these men for scientific insights and discoveries, we should remember that science and philosophy were at the time not distinguishable enterprises.

Human nature as a scientific interest.—In the course of time, medievalism began slowly to disintegrate. Its doom was in truth foreshadowed in the rise of men of philosophic freedom and scientific spirit who persisted in fighting their way to non-theological descriptions and explanations of natural events. The era of natural science was dawning. Unfortunately, psychology had no one as yet to champion its naturalistic rights, and so for a longer time than was the case with physics, chemistry, and biology it remained outside the pale of science. Leonardo da Vinci, it appears, could say in the fifteenth century that "those sciences are vain and full of errors which are not born from experiment, the mother of all certainty" (3), but it was not yet supposed by even the most advanced thinkers that human nature could be approached by experiment. Assuredly, an age which could brand the Copernican theory of planetary motion as false because the theory was opposed to Holy Scripture was in no intellectual condition to accept a naturalistic interpretation of human nature, an interpretation that would be looked upon as flouting the supernatural dignity of man.

And it is this sense of dignity, born of emotionalized

faith, that has incessantly impeded intellectual advancement by obtruding irrelevant feelings upon judgments of facts and theories and by conjuring up imaginary consequences therefrom. In our own day the theory of evolution is condemned by many primarily because of a conviction that makes it appear unflattering to man and insulting to the Deity.

But theological and other misconceptions aside, we find another reason for the extremely slow scientific development of psychology, the elusiveness of its subject-matter. This elusiveness appears striking when one simply inquires: "Just what *is* a thought?" "Just *where* is an *idea,* say, of home?" "How, internally, does my *feeling of hatred* towards foreigners differ from my *feeling of affection* towards mother?" Such questions appear no less puzzling to us than to those investigators of centuries ago.

Here one may note again that in the period under consideration the old notion of human nature as constituting two kinds of living material—body and soul, or matter and mind—permeated all interpretations. The scientists of the Renaissance went ahead with experimentation upon physical things, at the same time admitting without question the separable existence of mind or soul. They conceived mind and soul to be of a different order from the natural. Therefore Harvey (1578-1657) could demonstrate the circulation of the blood and other physiological functions in mechanical terms and without reference to the soul as the moving principle. But no one could demonstrate psychological processes; these intangibles could only be argued about. So the scholars of the day tried to settle problems like the following: Does the odor of incense generate the idea of sanctity or vice versa? How does the soul connect with the senses? Is the soul the cause or the result of knowledge? How does the soul know itself?

Nowadays we would say that such questions are at least unanswerable if not downright silly. Of course, the medievalist with his theological preconceptions could solve his problems by a facile appeal to miraculous acts of Deity, as in the case of Thomas Aquinas, who readily referred to the Creator the question as to how body and soul are united. And in a later century even such an undisputed master of science as Newton felt constrained to explain the correction of certain irregularities in the solar system upon the basis of Divine intervention (3). But such explanations are utterly invalid from a strict scientific viewpoint, however pertinent they may be on theological grounds.

For it is characteristic of true science to modify its assumptions and even to abandon some of them whenever new factual discoveries necessitate new interpretations. Only thus can scientific progress be achieved. The Ptolemaic assumption of a fixed earth at the center of the universe was eventually proved untenable in the light of the researches and discoveries of Copernicus, Kepler, Galileo, and Newton. The Darwinian theory of the evolution of complex animal forms from simpler ones gradually displaced the view that these forms had been separately created. These changes illustrate the point that whatever the current problems of science happen to be, they are always formulated in terms of current knowledge and current assumptions. But assumptions, like entrenched beliefs, notoriously die hard. Modes of thinking that have become habitual always resist change.

Psychology influenced by common notions.—The involvement of psychology in the primitive notion of the dual nature of man led it to formulate its problems and to define its subject-matter in terms which reflected more nearly the ideas of the common man than was the case with the physical sciences. This fact will impress one the more if one simply observes how, from the days of

Copernicus and Galileo, physical science had developed its explanations of natural events in terms of such mathematical abstraction as to be quite incomprehensible to ordinary mortals; whereas even the psychology of today, in frequent instances, still adheres to numerous conceptions derived from pre-scientific interpretations of human nature.

THE MODERN DEVELOPMENT

At the beginning of the modern period (roughly the seventeenth century), we find the notion of the dualistic nature of man sharply defined by Descartes. This remarkable thinker, who made significant contributions in the fields of mathematics, physics, physiology, and psychology, conceived human nature on the side of body in terms of physical, mechanical processes, and on the side of soul in terms of spiritual and immaterial processes alone. The inevitable problem as to how the immaterial soul was connected with a material body he attempted to solve by postulating the location of the soul in the pineal gland (a tiny organ at the base of the brain) where it actuated body movements by means of animal spirits—a recourse to animism as an ancient explanation of motion.

Human nature as material for science.—The interpretation of Descartes developed into a doctrine known as "psychophysical parallelism," a doctrine which conceived the relationship of mental and bodily processes as distinct, non-interactive, yet parallel. Although this doctrine was contrived to escape Descartes' illogical solution, yet it left another dilemma: How does it happen, for example, that a pain (mental) is associated with an injury (physical)? This dilemma was resolved in two ways: Those who were still immersed in theological predilections resorted to explanations in terms of a continuously operating divine miracle; others preferred to use

the doctrine merely as a *methodological* device, that is, as a basis from which to investigate the nature of mental and bodily processes, leaving to metaphysics the problem of the ultimate unity.

With this device psychology proceeded to study the nature of mind, relinquishing to physiology the study of body. Of course, the division of labor between these sciences was not as clear-cut as the above statement might imply. We shall see later that psychology, for its part, had to take account of physiological advances and that physiology, for its part, could not proceed in indifference towards psychology. In particular, from the eighteenth century on, the trend of psychological inquiry took more and more a scientific form, putting forth prodigious effort in investigations of the senses, and thus at the start becoming involved in details of physiological structures and functions.

Strange to say, however, men whose interests were definitely psychological were not yet ready to abandon the soul as a means of explaining behavior. They felt the necessity of postulating some underlying unity to which the changing aspects of experience and behavior could be referred. One's ideas come and go, one's moods change, one alternates action with rest, one sleeps and awakes, taking up the same threads of thought and action even after lengthy breaks. How could these all be and oneself remain the same unless one has or is a soul or some such permanent "something"? Without this "something" one's own identity seemed inconceivable. Hence, even through the nineteenth century, psychology was variously defined as "science of the mind," "science of psychic phenomena," "science of consciousness," and "metaphysics of the soul." Yet, notwithstanding all this variety of definition, the demand for an independent scientific treatment of the facts of mental life grew apace.

Psychology becomes experimental.—When we reach the middle of the nineteenth century, psychology is definitely acquiring status as a science by virtue of its adoption of experimental techniques. In this connection it will be of interest to note that up to this time there have been no psychologists, that is, in the modern sense. Writers upon psychological topics, from Aristotle to the period just mentioned, were numerous enough. But men for whom psychology was a distinctive profession were hardly on the verge of the horizon. The real founders of the experimental science, as enumerated below, were primarily philosophers, physiologists, physicists, and physicians.

Germany provided most of the pioneers in the new science. *E. H. Weber* (1795-1878) as a professor of anatomy at Leipzig performed notable experiments on the senses. *Fechner* (1801-1887) was professor of physics at Leipzig, though he took his degree in medicine. *Helmholtz* (1821-1894) trained as a physicist and physiologist, became a surgeon in the army, and successively professor of physiology and physics. *Brentano* (1838-1917) pursued philosophy as a profession, was ordained to and later renounced the priesthood, and although not an experimentalist in the strict sense, yet remarkably influenced the development of scientific psychology. *Stumpf* (1848-   ) taught philosophy in various German universities and achieved fame by his pioneer experiments in the psychology of music. *G. E. Mueller* (1850-   ) began his career in philosophy but turned to experimental psychology. *Wundt* (1832-1920) prepared for medicine, taught physiology, physics, and anthropology, and founded at Leipzig, in 1879, the first laboratory of psychology, an event of historical importance inasmuch as it signaled to the academic world psychology's claim to scientific recognition.

In France, psychology developed mainly from the field of medicine. *Binet* (1857-1911) inaugurated the

movement of intelligence testing and helped to establish the first French laboratory of psychology. Other early experimenters were medical leaders: *Charcot* (1825-1893), *Ribot* (1839-1916), and *Janet* (1859-). Their fame lies in the special field of the psychology of the abnormal.

In England, psychology did not attain scientific status as early as in Germany and France, for reasons possibly attributable to the traditional conservatism of the British universities. Many of the experimental pioneers of English psychology are still in active service. *McDougall* (1871-), trained in geology and medicine, turned to psychology as a fertile field for his scientific labors, at first in England and later in America. *Myers* (1873-) also began as a student of natural science and is now an acknowledged leader in British psychology, especially in its industrial applications. *Spearman* (1863-) has made notable contributions to the theory of mental measurement.

In America, too, the first scientific psychologists belonged to other professions. *James* (1842-1910) prepared for medicine, taught physiology, founded the laboratory at Harvard, and spent his later years in philosophy. *Hall* (1842-1924) studied for the ministry, taught philosophy, and subsequently became president of Clark University. *Ladd* (1842-1921), too, was minister, philosopher, and psychologist.

Thus, in a period of approximately twenty-five years covering the last two decades of the nineteenth century and half the first decade of the twentieth, psychology developed into an experimental science under the guidance of men with varied academic training. And it is from the laboratories established by these men that students, specially trained as psychologists, have gone forth to cultivate the new scientific field.

Current trends.—Having now traced the emergence of our study from its matrix in primitive reflections, its

growth under the fostering solicitude of philosophy, and its début as a science under the coaching of physics, physiology, and medicine, one should be prepared to observe how at the present time it meets the problems set by human behavior. Psychology's stages of growth are roughly three: the study of the soul, the study of the mind, and the study of behavior. These stages represent important changes in its conception of its subject-matter, changes appearing as corrolaries of development.

The psychologist of today has no need for the concept of the soul. At least he cannot accept the soul as a sort of being which somehow manifests its existence in the form of ideas, feelings, strivings, and the like. Nor can he accept it as a sort of unifying principle which somehow underlies all the changing manifestations of human experience. Hence he is not concerned with the soul for the simple reason that *from the viewpoint of science* he does not need it to explain human experience and behavior. As a relic of animism it had long been excluded from physics and astronomy. It was being repudiated in the sixteenth century by physiology as a source of organic activity. And it was discarded by the psychologists of the nineteenth century.

Psychology as the science of mind.—These psychologists redefined the subject-matter of their science as that of *mind.* But today many psychologists maintain that the mind has no more scientific validity than the soul. If the mind be defined as some sort of thing, even though no theological notion be intended, it becomes merely a substitute for soul. Historically, as we have seen, the notion of mind was taken from the Greek conception of the rational part of the soul. However, the early experimentalists did not think of mind in the old substantive sense; they defined it rather as a *structure of psychic elements,* ascertainable through analysis. Thus, from their viewpoint, psychology is the science of mind. But

here, to be sure, is a problem: How did they *experiment* with mind?

We have seen how the founders of scientific psychology were for the most part trained in the physical sciences. This circumstance is significant; for it meant that these founders would bring to the investigation of mind the analytic procedure of the physical sciences. This they did, laying out a program of intensive search for what they conceived to be the irreducible constituents of mental make-up. Their search took the form of *introspecting* the inside, so to speak, of individual consciousnesses; which means that when one is asked to describe what is *in* one's mind at any moment one does so in terms of what one *sees* (colors and forms), *hears* (tones and noises), *smells* (odors), *feels* ("peppy" or gloomy), and so forth.

But, by this type of analysis, one never discovers one's mind as any sort of single object. All that one can do is to infer mind as an organization of those psychic factors which introspective analysis reveals. And organization implies structure. And so a famous pupil of Wundt (Professor Titchener) was led to declare, "The structural psychologist must be able to say: 'Give me my elements, and let me bring them together under the psychophysical conditions of mentality at large, and I will guarantee to show you the adult mind as a *structure,* with no omission and no superfluity' " (7). In this statement one finds epitomized the avowed aim of the early experimentalists, namely, to reveal the mind as a composition of psychic elements.

Now this method of analysis implies no appeal to an unknown *entity,* whether of soul or of mind. It simply denotes a *method of describing* what actually happens in consciousness and, in so far, the method exhibits the scientific spirit. An old difficulty, however, lurks in the implied distinction between the psychical and the

physical. For if one should inquire what are the "psychophysical conditions" referred to above, one would be informed that they are the mechanisms of the nervous system (8). Somehow a mental activity occurs with a physical activity, though the two are conceived to be in essence distinct. Hence the mind-body relationship again is defined as a parallel series of events, the one mental, the other physical; but neither is the *cause* of the other. A given event, say, a colored object before the eyes, may be regarded as mental or as physical, depending upon one's scientific point of view. As mental it is a visual experience; as physical it is a composite of wave-lengths. Psychology studies the experience; physics studies the wave-lengths.

It was upon this sort of distinction that the psychologists of the first laboratories formulated their program of experimental analysis of mind. And by this program they have accumulated a prodigious amount of factual material, particularly in the field of sensory experience.

Psychology as the science of behavior.—Opposed to this structuralist or introspectionist type of psychology, one finds in the second decade of the present century a new movement known as *behaviorism.* The promoters of this movement, called behaviorists, took the position that to define psychology as the science of mind was to hark back to the old notion of the soul (9). They reproached the structuralists for preserving, in the concept of psychophysical parallelism, an outmoded, illogical, and unscientific principle.

Accordingly, the behaviorists hoped to make psychology truly scientific by redefining it as the *science of behavior* and by eliminating entirely all reference to mind, consciousness, or the psychic. They proposed to wipe out all distinctions of mental and physical by resolving all facts of human nature to purely physical terms. Activities heretofore defined as mental were now

to be identified as nothing other than physical activities in the neuromuscular system of the body. To quote from behavioristic writings: "Human responses conform to the strictly physical or mechanistic causal categories and exclude non-biological or psychic factors" (11). "Behaviorism claims that consciousness is neither a definable nor a usable concept; that it is merely another word for the 'soul' of ancient times" (9).

Such a redefining of psychology was no less than revolutionary. It called for a complete revision of the conceptual framework of the science. Henceforth the program of scientific psychology was to consist of painstaking analysis of *organic movements.* And by this analysis the behaviorists meant a reduction of *all* human activity, including such aspects as thought, desire, feeling, and imagination to *simple neuromuscular units called reflexes.* Any instance of behavior, from a simple eyewink to the planning and execution of a military campaign or the composition of a symphony, is to be explained as a compounding of elemental reflexes under the stimulation of mechanical forces. But no matter what the behavior, consciousness plays no determining rôle whatsoever. Man is just a physiological machine, and it is the business of psychology to inquire how the machine is put together and how it works.

Such, in briefest outline, is the behavioristic thesis. Again, as in the case of the structuralists, the behaviorists, by their methods, have added much to our knowledge of the workings of the human organism. Yet, doubtless, they have gone to an extreme in denying so flatly the rôle of consciousness in human activity. At any rate, the program for psychology as the science of behavior requires the consideration of all facts pertinent to an understanding of behavior. To be sure, a scientific method of reductional analysis casts some light upon psychological problems. Yet whether or not this light

is entirely adequate for revealing the whole plan of human nature is a question of fundamental importance.

Meanwhile, one may observe that in spite of all their scientific ardor the behaviorists have not succeeded in laying low the old ghost of dualism. Paradoxically enough, the intensity of their objections respecting a "psychic" psychology is at least a tacit assumption of something to quarrel with. And, on the other hand, to insist on explanations solely in physical terms carries an implication of contrast with the non-physical. Dualism still hovers in the offing.

The organism-as-a-whole.—At the present time the viewpoint is gaining considerable weight that behavior is to be understood as the activity of the total organism rather than as a summation or aggregation of parts. It is a viewpoint embodying a protest against the assumption that a scientific explanation must necessarily be based upon a scheme of reductional analysis. This sort of protest can be traced as far back as the Greek philosophers (5). Among modern psychologists, James, McDougall, Wertheimer, Köhler, Koffka, Ogden, and Wheeler, to mention a few of the outstanding ones, have vigorously renewed the protest. But in scientific circles such a protest would rightly go unheeded unless supported by experimental evidence of an undisputable kind. Such evidence is at hand and is compelling a modification of those interpretations of behavior which derive wholly from methods of reductional analysis.

Further considerations of method will be taken up in the next chapter. For the moment one may note that the mind-body dualism passes into the limbo of discarded concepts as one adopts the viewpoint of behavior as a functioning whole. No distinctions need be made in terms of mind and body. The problem of interpretation is no longer one of differentiating the mental from the physical either directly or by implication. The prob-

lem is rather one of understanding behavior *as* behavior, that is, as the *activity of an organism taken as a concrete whole in interdependent relationships with environmental conditions.*

In line with the newer physics, which dispenses with matter in the sense of a scientific ultimate, the newer psychological trend dispenses with soul, mind, and body as scientific ultimates. In fact, physics, biology, and psychology appear today to approach common ground by way of the *concept of organism,* since the electron of physics and the organism of biology and psychology seem to reveal fundamental similarities as types of organic unity (12). However, further consideration of this point, interesting as it may be, lies beyond the scope of this book.

In brief, the first half of the twentieth century finds psychology pursuing its course as a natural science in the special province of behavior. Many avenues of investigation have been opened up; some of these follow lines of introspective analysis; some follow lines of analysis of reflex patterns; and others are concerned with the problem of behavioral adjustment to varying environmental situations; but all eventually converge towards the goal of an adequate understanding of human nature.

PSYCHOLOGICAL TOPICS

At this point it would be of advantage to survey briefly the main topics comprising an introduction to psychological science.

In observing an individual's behavior, even casually, one readily notes how it varies and adapts to changing circumstances. If in so doing the individual attains an *improved* status, then he is exhibiting the behavior characteristic of *learning* or *intelligence.* This characteristic is perhaps the one of greatest importance to the individual in his everyday adjustments, inasmuch as it repre-

sents the very foundation of his success or failure. It should accordingly receive initial attention in a psychological study such as this one so that one may, by knowing what the nature of learning is, what its conditions are, and how it may be refined, obtain a decided practical advantage at the very outset.

Other observations in everyday life impress us tremendously with the rôle that *feeling* and *emotion* play in human affairs. Scarcely any situation arises in our social relationships without some display of anger, fear, elation, depression, affectionate interest, and so forth. Without these, indeed, as is often remarked, life would not be human. At any rate, they are integral aspects of human personality, and they merit, as such, a considerable psychological attention.

Still other observations point to characteristic human capabilities in the form of *thinking* and *imagining*. By reason of these the variety of human activity and adjustment ranges and expands virtually to infinity. For they are the primary psychological instruments of creativity—that quality of behavior by which man rises above his natural environment to achieve an ever increasing richness of experience.

But learning, feeling, and thinking turn upon other psychological activities of *sensing* and *perceiving*. Although these pertain to the structural aspects of behavior, in large measure, they are nevertheless important aspects in so far as they illuminate the details of behavioral adjustment in terms of one's reactions to the sights and sounds, the smells and feels, and so forth, which influence one toward this person or away from that object.

All the foregoing topics as modes of behavior should be recognized only as modes or features of a functioning totality called *personality*. After all, even the psychol-

ogist, dominated as he may be by interests of a purely scientific nature, must freely admit the practical importance of the science of psychology for a more clarified understanding of personality than non-scientific viewpoints can afford. This practical importance, therefore, finds acknowledgment in this book through discussion of the problem of personality, methods of determining types, and the socially significant question of cultivation.

PSYCHOLOGY'S SCIENTIFIC RELATIONS

Besides psychology, a number of other sciences include the human being as a subject of investigation.

Biology takes into its scope all living phenomena. It studies the various organisms, their functions, structures, and evolutionary origins and development. It elaborates for psychology the problems, theories, and facts of heredity. It provides a great deal of information about the mechanisms of organic adaptation to environment. Through its division of *physiology* it describes the integrative mechanisms of the nervous, muscular, and glandular systems and their importance in the formation and modification of behavior patterns.

Anthropology studies human nature from the viewpoint of cultural origins and processes. It delineates the characteristics of primitive social organizations, racial groups, tribal life, manners and customs. To a large extent anthropology may be defined as the science of folk psychology. Indeed, a number of psychologically trained men have made valuable contributions to anthropological science.

Closely related is the science of *sociology*. Its scope comprises "the study of the principles underlying man's social relations" (6). In this capacity it studies group behavior patterns as observed in custom, fashion, law, and so forth. It discusses environmental pressures which affect migrations and racial problems, and provides the

scientific knowledge requisite for controlling poverty and crime. In fact, sociology and psychology find a common mine of operations in the special field of *social psychology*.

As Bentley has well said, "We count our brethren among the biologists, the neurologists and the students of early man; our cousins among the biometrists, therapeutists, and promoters of hygiene; and our more distant relatives-by-adoption among such diverse strains of kinship as the historians of the law and of custom, the acoustical and optical engineers, personnel researchers, and physicists speculating upon the nature of the cosmos" (1).

With each of these sciences psychology shares the privilege of mutually accepting and supplying the results of investigations. Between these sciences there should be no rigid lines of separation. For the field of human nature is so vast, its data so complex, its approaches so numerous that no one of these sciences can possibly substitute for, but only supplement, the others. Thus, from a full recognition of their common scientific enterprise and interdependence, there will inevitably ensue considerable interstimulation towards the attainment of dependable knowledge upon every phase of human nature.

PSYCHOLOGY'S RELATION TO PHILOSOPHY

In view of psychology's historical associations with philosophy, so frequently noted in this chapter, we should note as concisely as possible what the present relationship of these two fields of inquiry is.

But, first, what of philosophy itself as a human enterprise? Traditionally it signified the whole of knowledge. This view, however, has been abandoned as an obviously impossible conception. Again, philosophy has often been regarded as the mother of all the sciences from whom each of them in turn has weaned itself away, establishing

itself in a house of its own. While this viewpoint carries historical weight, it cannot be wholly true, inasmuch as it suggests the implication that the sciences can readily dispense with philosophy as soon as they have matured. If, however, one takes the modern position that philosophy has as its indispensable rôle that of a *critical evaluator* of concepts and assumptions, one sees that it functions as a vital supplement to scientific methods and conclusions.

That this latter viewpoint is the truer one can readily be appreciated upon observing how philosophical the sciences themselves become as they strive to achieve an orderly conception and interpretation of the facts of nature (4). Thus a contemporary philosopher suggests as the peculiar task of philosophy "to introduce order and consistency into our vision, to remove pleasing but illusory plausibilities by contrasting various views with their possible alternatives, and to judge critically all pretended proofs in the light of the most rigorous rules of evidence" (2).

With this task in view philosophy takes the basic assumptions as well as the results of the particular sciences, subjects them to critical evaluation, and in the light of this evaluation endeavors to construct a meaningful, unified conception of the world and of life. Hence philosophy is neither antagonistic nor superfluous to the sciences, as is often mistakenly thought. On the contrary, it becomes a necessary coördinator of the sciences.

With psychology, in particular, philosophy connects specifically by the bridge of *ethics*. Whereas the *facts* of behavior, as brought to light by psychological research, provide the material for the science of psychology, the *evaluation* of behavior as good or bad, right or wrong, desirable or undesirable, requires an ethical standard which it is the business of philosophy to determine.

SUMMARY OF THE CHAPTER

In tracing the origin and development of psychology a number of illuminative and epochal facts appear: *first,* the rise of psychology from primitive ideas of a soul as the actuating principle of behavior; *second,* the refinement of these ideas by the Greek philosophers into a dualistic theory of human nature; *third,* the shaping of this theory by the medieval theologians into a spiritual, though dogmatic, interpretation of human life and destiny; *fourth,* the subsequent hazardous attempts to elevate psychology to the plane of the natural sciences and the eventual success of these attempts in the latter half of the nineteenth century; and *fifth,* the rise of alternative schemes of interpretation of experimental facts—schemes involving differences of methodological approach and emphasis.

So psychology arrives. One need not be disconcerted over variations of interpretation. For these variations express both the youthful vigor of the science as well as the unresolved complexity of its material. What material could excel human nature for complexity? Yet in these respects psychology is not in disparity with other sciences, particularly those of *living* material. Naturally, the important thing for any science is first of all to ascertain what are the facts pertinent to its special field, then to formulate the most adequate interpretation of those facts. Still, this procedure is more of an ideal than an actuality; for obviously one cannot wait until *all* the facts are in. Science must interpret as it discovers, or else discovery itself would cease.

Where alternative interpretations appear the student of psychology should endeavor, in so far as his background of knowledge allows, to evaluate their merits in order to broaden his viewpoint, sharpen his judgment,

and lay a sound basis for his own conclusions. To do so is to adopt the genuine, critical attitude of science.

QUESTIONS FOR DISCUSSION

1. Of what significance for psychological science is the persistence of outmoded expressions?
2. How would you account for the late development of psychology as a science when compared with physics and biology?
3. What motives impelled psychologists to redefine their science as the study of behavior?
4. Make clear to yourself the differential approaches of modern psychology. Are they necessarily antagonistic to each other? Why, or why not?
5. List a number of problems which you think psychology may properly undertake to solve.
6. In what respects do psychological problems interrelate as problems for other sciences? Justify Bentley's statement.
7. Point out the more important applications of psychology for vocational and avocational interests.
8. What is meant by the critical attitude of science, particularly in relation to psychology?

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CHAPTER II

WAYS OF PSYCHOLOGIZING

From the brief historical survey outlined in the first chapter it will be recalled that psychology's progress from primitive reflection to scientific observation was greatly impeded by two factors: first, its object of study—human nature—had persistently been regarded as not amenable to scientific treatment; second, interpretations of human nature, current at any age, tended to become fixed in popular usage and consequently to resist change.

To be sure, in this second instance psychology is not unique. Practically every science has suffered retardation from the inertia of traditional ways of thinking, though in respect to psychology this inertia seems to have been of a more resistive character, partly on account of the comfortableness of such ways of thinking and partly by reason of pride of opinion. For, respecting this opinion, the ordinary person is apt to be far more complacent towards explanations of events like planetary motions and change of seasons in terms of natural law than he is towards such explanations of his own most intimate thoughts and feelings. As regards the latter, indeed, he would feel constrained to remark, "Who wants to have the devotion of his fiancée scientifically explained?"

Besides, everyone who comes for the first time to the study of psychology inescapably brings with him an assortment of opinions about human behavior, opinions acquired from the heritage of common-sense judgments, miscellaneous literary sources, and observations of social

contacts. These opinions may seldom have been challenged by the individual who holds them, and their impact against scientific interpretations, therefore, sometimes produces in the individual a sense of incompatibility more or less disturbing. However, to obtain a sound basis for the understanding of human behavior one must assess these non-scientific sources and cast them in bold relief upon the background of scientific method.

This chapter, accordingly, will set forth the characteristics of common-sense psychology and of literary psychology, as these reflect non-scientific interpretations of human nature, and will contrast them with scientific conception and method.

COMMON SENSE AS INTERPRETER OF BEHAVIOR

When confronted with a puzzling situation, personal or social, the advice one is familiarly apt to get is, "Why don't you use common sense?" And this advice, on occasion, may even prove quite unflattering to one's intelligence when put in the alternative form, "Why don't you use plain horse sense?" This implied tribute to a very human, or sub-human, principle of guidance, however, may be both confusing and embarrassing.

What common sense means.—In speaking of a common-sense point of view, one may, on the one hand, refer to expressions of attitude or judgment whose characteristics are termed unsophisticated, wholesome, balanced, corroborated by experience, and so forth; and, on the other hand, one may think of common sense as rather naïve, trustful of sense impressions, gullible, and unreflective. In ordinary use, of course, there is no precise distinction of meaning. Still, for the most part, the context of the writing or the conversation will indicate the particular meaning intended.

At any rate, the contrast of common sense with science is that the former denotes implicit trust in unreflective

judgment. Here the interpretation of behavior is apt to be a medley of naïve conceptions based upon ordinary sense evidence or derived unquestioningly from traditional sources. And, curiously enough, in this medley one may find items of interpretation that do have a genuine scientific foundation; though common sense characteristically fails to distinguish what is scientific from what is not. It characteristically fails because it lacks the *critical insight* which comes only from training in rigorous analysis, from disinterestedness of attitude, and from a willingness to pursue an investigation wheresoever it may lead.

It is typical of common sense, for example, to perceive things and events in relation to *personal desires.* During the Great War the allied peoples readily accepted the reports of German "atrocities" because such stories accorded with the desire to have the Germans condemned by world opinion. One may fail to credit a rival with qualifications that he obviously possesses—obviously, that is, to an impartial observer. And one may place a halo of excellence about the person of a loved one or admired one. Such cases illustrate what William James once called "the will to believe" (9), and are indicative of the common failure to detect the more subtle influences upon judgment of bias and prejudice.

It is also typical of common sense to formulate its interpretations from *mere surface effects.* Perhaps no clearer illustrations of this tendency can be obtained than from the tactics of the political orator and the religious revivalist. Their tricks of vocal inflection and use of vividly descriptive adjectives induce emotionalized effects in their hearers, effects which tend to inhibit whatever critical inclinations the hearers may possess. In commercial advertising, also, the psychology of line and color arrangement, of attractive wrapper, of elegant setting, and of illusory size of package, appeal most success-

fully with the artless observer. And though one may be convinced that "beauty is only skin deep," yet beauty notoriously "spreads over" to become for the naïve a symbol of all-round excellence.

Moreover, common sense characteristically draws conclusions from *chance occurrences* of things and events. Particularly is this true, psychologically, in the matter of judging character, whether from so-called external signs or from casual behavior. The naïve observer tends to conclude from mere *analogy* that typical features of bodily appearance denote corresponding character traits, assuming, for example, that a bullish thickness of neck is a sure sign of a stubborn nature. Dependence upon chance occurrence is seen in the judgment of a person as guilty or unreliable from an appearance of embarrassment under sudden questioning.

All such instances typify the flimsiness of the basis of common-sense interpretations. Many of these, it is true, prove harmless enough in ordinary social relationships; though it is not to be denied that on occasion they may so grossly mislead one as to jeopardize one's future. In this connection, one needs but to remind oneself of the myriad superstitions that from time immemorial have enthralled and misguided human conduct, often with terrifying consequences, as in witch-burning, heretic-hunting, and futile enterprises like the Children's Crusade. Even today, as shown in a recent study of the prevalence of superstitious beliefs among college students, notions long since exploded in scientific circles are still clung to as true and as influential in daily life. And despite exposure to scientific method in college courses, the seniors are not much better than the freshmen on the score of enlightenment (6).

While it is undoubtedly true that the spread of scientific knowledge eventually drives these superstitious notions into intellectual discard, nevertheless such knowl-

edge must be genuinely integrated into the everyday thinking of individuals for it to be really effective against these notions. Yet from the fact that students in colleges may pass through courses in science without having their misbeliefs subjected to criticism, pried loose, and destroyed, one need not be surprised at the number of potent misbeliefs upon the part of those who have never been exposed to scientific training.

Respecting human nature, indeed, there appears to be far greater risk of misconception and misbelief than is the case with the rest of nature, partly because of frequent emotional attachments which render an impartial analysis unusually difficult, and partly because human behavior itself is an exceedingly variable affair, so variable in fact that scientific psychology, to be reasonably sure of its results, must expend considerable effort in controlling conditions of observations.

Common sense needs correcting.—In view of all these considerations, cultivation of the scientific attitude towards the problems of behavior becomes of supreme importance. Essentially this attitude is critical. It is critical of conclusions influenced by human desires. It is critical of interpretations derived from superficial observations. It is critical of claims which appear to rest solely upon someone's "say-so." Cultivation of this attitude enables one to detect the insidious operation of bias in the direction of observation as well as in the formation of conclusions, whether the bias be due to the wishful thinking of common sense or to the dogmatic position of an authority. No scientific credence, for example, could be placed upon psychological conclusions formulated to accord with a preconceived political theory of human nature, as in the case of Marxism, or with a preconceived theological conception.

Curiously enough, though one never hears of a Marxist physics or a Presbyterian chemistry or an Episco-

palian astronomy, yet one does hear, even today, of the attempted molding of psychology to accord with some established school of political or religious thought. One reason for this situation, as we have noted, is that human behavior, as the most intimate of all subjects of study, has long been the field of exploitation by all sorts of non-scientific interests which have sought to understand it and to bring it under control. Another reason is to be seen in the *fear* which prompts churches and governments to "protect" their youth from "error."

But cultivation of the scientific attitude requires that one divest oneself of all notions which preclude an impartial assessment of the facts and interpretations of human behavior. And it is precisely because common sense cannot make this sort of assessment that it is unable to shed any clear light upon the problems of behavior. Of course, common sense does not realize its own limitations in this regard; for it is only by inculcation of the scientific attitude that those limitations become realized.

These considerations become vivid whenever it is necessary to determine the relevancy of particular facts to a particular interpretation and also to distinguish fact from fiction. It is still a common belief that night air is inimical to health, in spite of medical science's evidence to the contrary. And it is still commonly held that women are intellectually inferior to men, in spite of psychology's proof of the contrary. These cases represent the sort of generalizations which common sense is prone to make from observations uncontrolled by scientific principles.

Common sense as traditional wisdom.—Of course, it should be recognized that for many ages man possessed no scientific knowledge whatsoever as we in this modern age understand science, and consequently man had perforce to guide himself on the basis of traditional wisdom

as this was transmitted from generation to generation by precept, code, and example. And this traditional wisdom, largely constituted of common-sense judgments, continues to serve to a considerable degree as the basis of the viewpoints of the man of the street today.

Moreover, this traditional wisdom, when clung to tenaciously, primarily because of its hallowed prestige and congruence with common sense, hinders the progress of scientific understanding. Old ways of thinking are often considered best because familiar and easy. To think scientifically may involve a sharp wrench of viewpoint. And the dereliction of common sense is that it is disinclined to suffer this wrench. Hence a breach is formed with science, a breach that is particularly evident in the rise of a variant terminology. For with greater care in the establishment of facts there is greater preciseness in the description of them. Accordingly, the language of science operates on a different level from that of the common man, often to his discomfiture and irritation. He then seeks refuge in decrying science as so much "jargon."

But the history of civilization shows clearly that the path of science is the one safe path man has yet blazed whereby he may escape the jungle of contradiction, vagueness, and confusion, in which common sense tends to flounder.

LITERARY MASTERS AS INTERPRETERS OF BEHAVIOR

It was the literary masters of the ancient world who took the wisdom of the untold ages and, by creative imagination, distilled from that wisdom those resplendent conceptions of human nature which we find portrayed in drama, poetry, and historical narrative. And from the ancient world to the present an important function of literature has been the delineation of human personality in its development, discord, and demise.

Literary psychology.—Whenever, as delineators of personality, the literary masters suggest or offer explanations of personality, they become, willy-nilly, psychologists; and their portrayals may then be defined as literary psychology. To be sure, not all creations of literary art attempt or imply explanations of human nature. Doubtless, for the most part, they merely aim to *represent* characteristics of mood, of insight, of stupidity, and of cupidity in order that readers might appreciate these characteristics through empathic reaction.

Literary psychology, common sense, and science.—The viewpoint of literary psychology is much more reflective than that of common sense, though in numerous instances somewhat less concerned than science with technical exactness of description and interpretation. Literary psychology, however, is akin to common sense in so far as it tends to adhere to traditional concepts. One motive here is doubtless to be ascribed to the necessity on the part of writers for preserving a bond of union with the common-sense level of appreciation, a motive which science tends to ignore if not to repudiate. Another motive is the individualistic one of interpreting human behavior as well as other natural events from the viewpoint of personal desires and feelings, as exhibited *par excellence* in literary romanticism; whereas science is essentially non-individualistic.

But literary psychology has kinship with science, too, in so far as its expositions of human character utilize the scientific conceptions of the day. In this respect one might regard the history of literature as reflecting the progressive stages of scientific explanation.

Some aspects of literary psychology.—There is an indisputable tendency on the part of many writers to offer explanations, directly or by implication, for the personality trends of the characters they portray. These explanations may be in terms of some supernatural

power—providence or fate—of social pressures, of types of training, of instinct and heredity, as well as of glandular disturbance and mental disease (13).

For example, *biographers* sometimes deliberately undertake to outline psychological charts of personalities, the details of which they derive partly from ascertainable facts and partly from conjecture. Indeed, every biography that is more than a mere stringing together of factual data represents an invention, however plausible and fascinating it may be. Gamaliel Bradford, for whom *biography was psychography,* aptly put the case by contending that the biographer should be able to take a single utterance of his subject's and see reflected in it the bare soul (2).

This statement illustrates the proneness, patently unscientific, on the part of numerous biographers to explain a whole character on the basis of some isolated detail or single trait. But Bradford himself is not unmindful of the danger here when he writes, "Are we justified in generalizing such speech and action to the establishment of certain qualities by which the man may be permanently labelled for posterity? It is evident that the determination of this point requires long training and discipline in the nice analysis and estimate of human motives, and even with such training and discipline, one is likely to err quite as often as to be correct" (3). A better statement than this of the viewpoint of the literary psychologist would be hard to find.

Moreover, the *poet, novelist,* and *playwright* may offer interpretations of human nature, unfolding in plot and theme the interplay of character and environment. It is true, as previously noted, that writers often seek to explain the behavior of their characters by means of current scientific conceptions. Thus one may happen upon such a laudatory comment as this: "There is no author who has a more profound knowledge of mental processes

than Shakespeare" (14). Doubtless this is true enough. Shakespeare's plays are a veritable gold mine of Elizabethan psychology, a great deal of which finds utility even today. In fact, with a more or less radical change in terminology, most of Shakespearean psychologizing would sound familiar to modern ears. For it is the universality of his portrayals which renders Shakespeare's types of character as real today as ever. The melancholic Hamlet, the sanguine Falstaff, and the phlegmatic Audrey may typify Elizabethan theories of temperament, but they may readily be clothed in modern psychological language and thus be quickly recognized as living types (15).

And even the *historian* becomes a literary psychologist in so far as he construes a given course of events as a consequence of the character traits of the personalities involved. Doubtless, in numerous cases, it is impossible to understand events except as markedly influenced by personalities. However, the danger in interpretation here is to pass in a facile manner from mere plausibility to assumed actuality. The point is that all interpretation involves the making of inferences, and inferences are quite often lacking in scientific cogency. Particularly is this true of the rather facile appeal to so-called hereditary traits in explaining an historical event or sequence of events. And the same is true of explanations of racial temperaments and other psychological characteristics as precipitants of war.

SCIENCE AS INTERPRETER OF BEHAVIOR

In contrasting the way of science with the ways of common sense and literature one should keep in view two points of significance: *first,* that scientific method may be said to have emerged from these other ways as points of departure; *second,* that science itself often fails to provide explanations of many aspects of nature and of

human nature and hence, by reason of the incessant human demand for explanations, the gaps of scientific knowledge become filled with non-scientific as well as unscientific interpretations. One therefore needs some touchstone of reliability, so to speak, upon which to test these interpretations. And this one finds in scientific method.

Can behavior be studied objectively?—Upon raising the question of objectivity, one is reminded of the alleged elusiveness of the subject-matter of psychology which we noted in the preceding chapter. And because of this elusiveness it has often been doubted that psychology could ever be a science, at least on the level with the physical sciences. However, in the following paragraphs, one will see that the question of objectivity is, after all, a quite relative one and one that will, on close scrutiny, apply with similar force to all sciences.

From the traditional viewpoint, of course, one can easily see the basis for the question of objectivity. For of all things, the soul, in all its varied aspects, was distinctively intimate and personal, and thus seemingly inaccessible to impartial study. And even from the more modern viewpoint, as represented in introspectionism, the investigation of such personal matters as feelings, ideas, memories, and so forth was open to the charge of futility in respect to material for science, a charge which the behaviorists quite strenuously made.

Although, from the viewpoints of both the behaviorist and the organismic psychologies, these personal matters become redefined in behavior terms on the ground that behavior is objective rather than subjective, yet one cannot escape the fact the behavior itself, one's own at least, is also intimately personal. So then, if one should designate as *subjective* those facts of psychological investigation which are intimately personal, one would find it difficult, if not impossible, to differentiate in terms of

objectivity and subjectivity between a toothache, let us say, and a habit of chewing one's finger nails. The one is as personal as the other.

The fact is that every observation is in a sense inescapably personal. As Köhler has effectively shown, psychology is in this respect no different from physics or chemistry (12). Despite the common belief that these sciences concern themselves exclusively with so-called objective phenomena, the truth is that as far as reported observations go—the reading of a pointer on a scale, for example—no one could tell whether the observations were made by a physicist, a chemist, or a psychologist.

And if, for the sake of further example, one considers the phenomenon of color, one discovers this to be a subject of investigation for both physics and psychology. But does color suddenly become objective when studied by the measuring devices of physics, and suddenly subjective when studied by the techniques of psychology? Such a distinction, when thoroughly reflected upon, betrays its own dubiousness. For in reality, *all* observations in *any* science are objective *and* subjective; objective because, by virtue of verifiability, they serve as a basis for further observations as well as for predictions, and subjective because they are inevitably products of individual or private sense impressions.

The usual procedure of a science, however, is to ignore the subjective aspect of observation, assuming that multiplicity and variety of observations by numerous trained observers "irons out" the subjective factor and renders the results objective or independent. By this means the variable factors resulting from the so-called personal equation become nullified. And we may thus understand, on the one hand, how an error in measurement may be corrected, as in the famous case of the observatory assistant who was dismissed for miscalculating the transit of a star, and, on the other hand, how an imagined

object may be unverifiable, as, for example, an hallucinated "vision."

To explain or only to describe?—Observations evoke descriptions. Scientific method, it is sometimes held, involves description as a primary feature and explanation as but a secondary feature. Doubtless this distinction is open to the objection of artificiality and misconception.

At any rate, in reading any scientific account that professes to be pure description, one should be on one's guard against the possibility of a subtle use of descriptive terms as though these were also explicative of the thing or event described. Not that there is an insidious motive of deception lurking in the description, but that the ever-present human tendency is to give *reasons* as well as simple descriptions. For pure description is really *mere enumeration* of aspects, things, or events, and as such is inadequate as an account of them. Few, if any, persons are satisfied with merely finding out *what* a thing is. Everyone is curious to learn *why* it is. Hence it is more likely that a particular description will imply an explanation, just as a particular observation evokes an interpretation.

As usually defined, the descriptive aspect of scientific method purports to answer the question: *What is this?* (*a*) by analyzing the *structure* of the thing being considered, telling how it is made, or (*b*) by pointing out *what is happening* under the particular observation. For example, (*a*) one describes a man by enumerating structural parts such as bones, tissues, fluids, cells, and so forth, and by noting the arrangement of these parts in the complex whole; and (*b*) one may note that a person's face blanches upon reading a telegram that is handed to him.

In contradistinction, explanation purports to answer the questions: (*a*) *How does this occur?* by noting the

conditions under which the particular object appears, and (*b*) *Why does this happen?* by referring to the related *goal* or *purpose*. For example, (*a*) one may observe that a child coos only when caressed, in which case one would say that the cooing is effected by the caressing; and (*b*) one may note that the cooing is related as a goal-activity to the child's desire for the caressing.

How psychology experiments with behavior.—From the paragraphs just preceding, one will infer that analysis is an important feature of scientific method. Everyone who has had some acquaintance with science, whether by first-hand laboratory experimentation or by cursory reading of scientific literature, usually understands by analysis the "breaking-down" of any material or investigation into simpler structural units. This sort of analysis, as a scientific procedure, is popularly supposed to be foreshadowed in the curiosity of the child, as exemplified in his taking apart an alarm clock to see "what makes it tick." But whether or not scientific analysis does represent the mature stage of childish curiosity, this fact stands forth, namely, that implicated in the taking apart of the clock is a complex scientific problem, the problem, that is, of the *relation between structure and function*.

Structural analysis.—For the moment, however, let it be understood that the analytic procedure of "breaking down" is called structural analysis. Referring to the paragraph above, this type of analysis represents the traditional scientific method of attempting to comprehend the nature of things, a method which tends to lead to a conception of nature called *atomism*. This type of analysis has already been recognized as the method of introspectionism and behaviorism; in the former as a means of seeking mental elements, in the latter as a means of seeking reflexes. In either case, observation is directed to the *make-up* of whatever is under investiga-

tion. Hence, strictly speaking, an atomistic view of things must contend that all differences in nature are at bottom simply *differences in complexity of structure.*

Moreover, the assumption underlying this type of analysis, when used exclusively, conceives the analytic process to be reversible; that is, the elements may be recombined, at least in theory, to form the whole which existed prior to the analysis.[1] Accordingly, the elements or parts when summated must equal the whole and presumptively provide the explanation for the nature of the whole.

The elements or parts, however, must be recombined *in a certain way.* Obviously enough, the difference between the child and a clockmaker stands out in the fact that the latter can take the parts and rebuild the clock, *but only because he can conceive the clock as the embodiment of a plan or arrangement.* And the plan or arrangement necessary to the apprehension of the whole cannot be ascertained from just a study of the parts as dissected and strewn about. A consideration of this sort is of the utmost importance, particularly for those sciences whose subject-matter is the living organism.

For structural analysis, applied to the living organism, is doubtless inadequate and, if used exclusively, quite misleading. A man *may* be analyzed into tissues, fluids, cells, and ultimately perhaps, into electrons and protons. But the result of such an analysis leaves the *man* out of account. What constitutes "man-ness" has vanished in the analysis. Hence it would appear that a different sort of analysis is needed if one is to preserve the very object of psychological investigation, namely, the man as a behaving organism. And the analysis which does so preserve the man is that of *functional analysis.*

Functional analysis.—This type of analysis is significant for its emphasis upon the organism-as-a-whole, its

[1] See Titchener's contention on page 16.

concern for explanation in terms of modifying factors, and its regard for the behavior of the individual as an activity of adjustment. By this analysis the psychologist seeks for an understanding of behavior through investigation of the conditions under which the behavior occurs. Some of these conditions are internal, that is, in the structure of the body itself—nervous system, glands, muscles, circulatory system, and so forth—and some of them are external, that is, in the environment of the body—temperature, activities of other beings, provision for nourishment, and so forth.

Thus functional analysis operates from the view that behavior is interpretable primarily in terms of an implicative system wherein the details of structure are to be seen as functionally interdependent within the organism, and the organism itself, taken as a whole, functionally interdependent with its environment. To assume otherwise, that is, to regard behavior atomistically, is to substitute an abstraction whereby the parts are wrenched out of their setting and treated as though they were separable existences. But in dealing with problems of behavior one should recognize that no living whole as such can be accounted for by any scheme, however refined, of reduction to elements (4, 10, 11).

Experimentation.—Analysis, whether structural or functional, is the intrinsic feature of experimentation. And experimentation is simply *controlled* analysis. By it the science aims, on the one hand, to guard observation from the insidious influences of personal likes and dislikes, and, on the other hand, to attain the greatest possible control of the material under investigation. These aims tend more and more with the progress of science to be expressed through mechanical devices and other laboratory techniques which lead finally, and perhaps ideally, to formulation in mathematical terms.

However, it is only in the so-called physical sciences

that these aims, particularly the latter one, can approximate fulfillment. And this is so because these sciences deal with aspects of nature that are not essentially tied up to intimate human interests,—planetary distances, atomic weights, gravitational forces, and such like—and also because they can more readily study their materials in abstraction from the concrete situations of life. Respecting human interests, indeed, the collisions of electrons leave one emotionally indifferent, but not so the collisions of personalities. And respecting the matter of abstraction, the electrons themselves illustrate the simplification and mathematical correlation characteristic of physical science.

Psychology, by the procedure of functional analysis, must deal with two sets of variables: the organism itself and the conditioning environment. But the control of these variables is often extremely difficult, if not impossible. The psychologist may quite effectively control the *external* conditions, as in a laboratory, but he cannot control to the same degree of effectiveness and precision the *internal* conditions of his human or animal subject, as instanced in mood, attitude, sensitivity, and so forth. And yet, if the psychologist would tackle at all scientifically the problems of behavior, he must take into consideration the nature of these variables and endeavor as far as possible to control them. This control he obtains to a large degree by refined statistical methods.

How this control is achieved the subsequent chapters will illustrate. In the present connection, however, these considerations of control imply the necessity for recognizing the problem that besets all sciences which deal with the living being, the problem, namely, of avoiding the inadequacy of abstraction and yet of dealing adequately with the concrete.

When science, then, in the form of psychology turns to the investigation of behavior, the procedure may take the

course of experimentation which aims at precise, mathematically stated results, in which case the control of conditions will be sought by means of mechanical devices, and the course of experimentation may be of the nature of statistical inquiry in which the mathematical results take the form of probability. To illustrate: psychology may take a case of behavior and break it up into structural elements (reflexes), as in the investigations of reading, where the number of eye-movements and blinks can be stated for every printed line of a test sheet and the results expressed in precise numerical terms; and psychology may take an individual's performances on intelligence tests and determine the results in terms of an average.

The following chapters will provide ample illustrations of the use of both types of experiment. Meanwhile, it is important to recognize again that scientific experimentation simply denotes a scheme of controlled observation whereby scrupulous care may be exercised in the discovery and reporting of facts. The facts may be relatively of the nature of particular observable things, as in the case of a brain lesion, or of the nature of a sequence of events, as in the case of panic ensuing upon feelings of uncertainty. In either case, for alleged facts to be scientifically acceptable, there must be agreement upon the part of various competent observers. Where such agreement is lacking, the alleged facts must be denied or held in abeyance pending further refinement of techniques of observation. Thus psychologists do not at present accept the so-called facts of mental telepathy because there is no agreement as to what these "facts" are, and because current techniques of experimentation are inadequate either to substantiate such "facts" or to deny them.

Introspection.—At this point one should consider again the use of introspection as a means of obtaining certain psychological facts. We saw in the first chapter how

scientific psychology began as the study of the elements of consciousness and how these elements were ostensibly ascertained through introspection. But whether these elements are real or not, psychology must make use of the introspective method. To give an account of how one *feels* in certain situations is often to provide an indispensable aspect of the whole behavioral reaction. One's introspective report of a "sinking sensation" or of a "dull ache" may carry vital significance in terms of resulting behavior, for example, telephoning to a physician. And though the report may refer to so-called subjective factors, they are hardly less real by being so classified. Moreover, they are problems demanding psychological consideration.

Indeed, one should note the fact that medical science depends to a marked degree upon introspective reports as guides to accurate diagnoses of the internal conditions of patients. And if one should contend that more reliable information is obtainable by objective, instrumental means, one should also recognize that such instrumental controls have been devised "partly on the basis of the introspective testimony of many patients and could not arise without such testimony" (5).

Introspection, it should be remarked, is not the same as *inspection.* As a psychological method the former represents a very specialized attitude of observation, an attitude acquired only by rigid discipline in the art of precise and resolute concentration. One should therefore not confuse this art or method with the more familiar attitude of pensivity or brooding. While this attitude may involve a sort of concentration, it is quite different from that which has a scientifically determined objective. But *inspection,* contrariwise, expresses all too often an attitude which fails to penetrate beneath the psychological surface, and for this reason proves deceptive.

The behaviorists, we observed, deliberately rejected the

method of introspection because of its subjectivity and presumed unreliability. But the problem of reliability here is precisely that of the reliability of any method of observation, namely, agreement upon factual results by trained observers. Errors may creep into any sort of observation; their detection depends upon methods of checking, of which agreement is one. But to abandon introspection on account of possible errors is, as Herrick well says, "too much like sinking the ship, cargo and all, to get rid of the rats" (8). That agreement has been attained by the use of introspection is evidenced by the behaviorists' own appropriation of the facts so discovered, as their own writings betray.

Measurement.—One of the recognized aims of science is the formulation of its conclusions in mathematical relationships, an aim, as we have seen, which effects a translation of the results of investigation into the symbols of abstractness and ultra-simplicity. However, this aim, when broadly interpreted, calls attention to the necessity for *measurement* as a means of obtaining a basis for comparing one set of facts with another.

In psychology, for example, one may wish to know the differences in speed of reaction to a traffic light and a policeman's whistle (sight versus hearing). To make this comparison requires precision of measurement, as by electric timing devices. Again, one may wish to know how the children of a given school or family compare with each other in intelligence. Here the psychologist would use an entirely different type of measuring instrument, the intelligence scale. Both types of measurement will be illustrated in subsequent chapters.

How psychology explains its experimental results.—Having now traced the main features of scientific method with particular reference to psychology, one needs to consider further aspects of scientific investigation,

namely, those concerning interpretation. Here one meets the problems of *assumption* and *hypothesis*.

These problems appear immediately upon asking the questions: "How does one begin to look for facts?" and "How should one arrange the facts discovered?" Of course, one need not imply from the form of the questions that facts are inevitably of the nature of particular things. Certainly, the scientific search is not exclusively analogous to that of the prospector looking for bits of gold in a mass of ore. Facts are never really separable in any such manner from their conditioning circumstances, in spite of the evident consideration that scientific inferences are all too often based upon the view that facts are necessarily discrete entities which exist in their own right, so to speak. Such a view implies the assumption that analysis of parts is the sole or main clue to the understanding of the whole.

Thus it is assumptions which guide the search for facts, set the course of experimentation, and lead to formulation of schemes of interpretation. These schemes, in turn, suggest fresh investigations and experiments to the end of accumulating further factual evidence which will tip the scales in favor of one type of interpretation or another.

Contrasting hypotheses.—A scheme of interpretation is called a hypothesis. Science must evolve hypotheses as theoretical frameworks whereby its facts may be arranged into a meaningful system. For facts of themselves could hardly suggest their own interpretation. Frequently, indeed, the same facts furnish the bases for quite opposite hypotheses. And it is characteristic of scientific endeavor always to harbor conflicting facts and rival hypotheses inasmuch as knowledge at any moment is inevitably fragmentary. However, the hypothesis which eventually prevails over its rivals is the one which offers the most reasonable or self-consistent explanation

of the facts available. Thus the Copernican hypothesis displaced the Ptolemaic, the Darwinian hypothesis that of special creation, and the hypothesis of relativity that of fixed magnitudes.

The guiding rule of hypothesis-making.—In the construction of hypotheses men of science have proceeded by the rule of accepting as true that hypothesis which covers all relevant facts with the fewest possible assumptions. This rule is known as the *principle of parsimony.* A difficulty, however, lies in determining just what facts are relevant. And on this matter men of comparable scientific ability and philosophical acumen will disagree, particularly when the facts themselves appear ambiguous in relation to a particular theory. Here the only appeal is to time.

Moreover, this principle of parsimony is susceptible of exaggeration in the direction of oversimplification. Thus, it is claimed that the attempt to reduce all behavior to physicochemical determinants involves an unwarranted extension of the principle. Aside from this tendency, however, the principle has proved efficacious in regulating speculation.

A corollary to this principle is Lloyd Morgan's canon.[2] This has pertinent application to sciences like biology and psychology inasmuch as it disallows any tendency to interpret animal or child behavior in terms that would be applicable only to adults. This tendency is characteristic of anecdotal descriptions, especially of animal behavior. Stories of "intelligent" horses counting and calculating by tapping a hoof, of dogs which "die of grief on the dead master's grave," and of the child who "lies like a trooper," belong to the Paul Bunyan type of psychologizing.

As a cautionary principle, this canon maintains that

[2] Formulated by C. Lloyd Morgan (1852-), an eminent British psychologist.

the simplest explanation is, scientifically speaking, the preferable one. But it, too, is susceptible of undue application, particularly by investigators in animal psychology whose mechanistic bias leads them to deny to animals the characteristic of insightful adaptability, even in the face of crucial evidence to the contrary (1).

DOES SCIENCE HAVE THE LAST WORD?

Considering the possible range of knowledge, the facts which any science discovers are, after all, exceedingly limited, both in number and variety. Nature presents an inexhaustible mine of puzzling, and seemingly infractious phenomena which scientific curiosity patiently and relentlessly unearths, scrutinizes, and sifts, hoping thereby to enlighten understanding and to facilitate human control. But in spite of the most modern refinements of method, the range and depth of understanding can never exceed that of relatively small samples of possible knowledge. Our inevitably finite discernments always must allow for possible complicating factors which do not, and may not ever, come within our ken. Hence it is quite appropriate to raise the issue, if only for purposes of recognition, as to the finality of scientific knowledge. And the only way to deal with the issue is to grant at the outset that science, as a human enterprise, can never reach beyond the limits of probability.

However, the moral of all this is not to evoke in us a sense of futility but rather to imbue us with a keener sense of responsibility for the advancement and application of such knowledge as we have. Limitations should never suggest abandonment. One who has tasted of the fruits of science can never consent to alternative figments of common sense. Certainly, as in the case of medical science, the present deficiencies of diagnostic methods, even though in numerous instances inevitable, incite no genuine occasion for denying the utility of this science,

least of all for taking flight into the quicksands of cultism.

And so in psychology, the fact that its conclusions never extend beyond probability scarcely calls for a reversion to the vagaries of popular conceptions. What is of paramount need is the recognition that relative meagerness of data and tentativeness of conclusions should serve to prevent hasty generalizations as well as to regulate the imaginative supplementing of fact through mystical speculation. For, as Dunlap avers, "Science offers only working hypotheses of increasing exactness of application. It does not pretend to absolute or final certitude. The man who demands such certitude must obviously find some other way, and the mystic does demand a shorter and easier way" (7).

Psychology, as does any science, finds its stimulus to endeavor in the very fact of insufficiency of knowledge and uncertainty of results. It therefore goes on investigating, experimenting, and revising, in the light of that pragmatic faith which sees in scientific method man's most trustworthy instrument of progress.

SUMMARY OF THE CHAPTER

This chapter has comprised an outline description of scientific method with particular application to psychology. In order to appreciate psychology as the scientific approach to the study of human behavior, it was necessary, first of all, to take cognizance of the non-scientific approaches as these are found typified in common sense and literature. The contrasting method of science took us through a discussion of the problem of the objective in relation to the subjective, the problem of description in respect to explanation, and the problem of types of analysis.

The importance of assumptions and hypotheses was then noted as they pertain to questions of interpretation.

Finally, the chapter considered the problem of the validity of scientific knowledge, and called attention to the fact that this knowledge inescapably bears the character of probability, a fact whose recognition presents to science the opportunity for progress and the challenge to further discovery.

QUESTIONS FOR DISCUSSION

1. Give five examples from your own experiences of the three bases of common-sense judgments.

What happens to these judgments when you scrutinize them?

How would you account for the prevalence of superstitious ideas after students have been exposed to scientific method?

2. Why might the common man decry science as so much jargon and yet freely accept many of the results of science?

3. Give illustrations from several sciences to support the view that science should not be guided primarily by practical necessities.

4. Differentiate literary from scientific psychology.

5. Why are we more likely to find more literary psychology than, say, literary chemistry?

6. Someone has said that both physics and chemistry are based on psychology. Elucidate.

7. What would be involved in a *description* of your present behavior?

What would be involved in an *explanation* of your present behavior?

8. Is your present behavior altogether amenable to scientific control? Why, or why not?

9. Differentiate introspection from inspection. What is the point of Herrick's remark?

10. State the problem of rival hypotheses in respect to science in general and psychology in particular.

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PART II

THE PSYCHOLOGY OF LEARNING

CHAPTER III

HOW WE LEARN

Already, the essential characteristics of behavior have been envisaged under the concept of adjustment. Life itself *is* adjustment. From the initial cry of birth to the final gasp of death, one's life or behavior constitutes a reacting to this and a reacting to that. A cool stream of air sends one shivering to seek warmth; a gastric disturbance compels one to seek a means of alleviation; a wisp of delicate perfume stimulates one to inhale more deeply and perchance to seek its source; and a smile of approval may put one on the high road to lasting achievement.

And all this reacting, to internal or to external stimuli, increases in complexity as one grows and matures. The stimuli, too, increase in complexity; they may be physical, in the sense of climatic conditions, sights and sounds, or pains and pressures, or they may be social—parents, brothers and sisters, teachers, and other persons. At all events, they take on an ever-enlarging context of meaning as one grows in sensitivity and in appreciation and thus in acquiring more and more meaning.

This growing and acquiring is learning. But learning is more than just growing and acquiring; it is also *retaining* what is acquired and *using* what is acquired for purposes of new adjustments. One may therefore be said to exhibit learning whenever one varies one's behavior so as to achieve some new adjustment to the circumstances in which one happens to be.

But learning, obviously, is not an exclusively human

affair. It characterizes behavior in lesser or in greater degree throughout the entire animal kingdom. Indeed, all experimental studies of animal and of human learning indisputably attest the evolutionary hypothesis of modern biology to the effect that no line of separation may legitimately be drawn between animal and human behavior. Consequently, from a survey of typical experiments upon animal as well as human reactions, one may obtain a workable conception of what learning in actual detail is.

One's learning may be more or less permanent; that is, a particular variation may be retained to a greater or lesser degree, depending upon future necessity for similar and further adjustment. And learning may also signify *intelligent* behavior in so far as one's behavior involves the selective utilization of past experience in achieving a new adjustment.

THE DISTINCTIVE SIGNS OF BEHAVIOR

In view of a current tendency to apply the same principles of explanation to the living as to the non-living (37), it would be advisable here to set forth certain distinctions that at least appear to challenge and to cast doubt upon such principles.

In the first place, *animal movement appears to be spontaneous*. This does not mean that behavior is uncaused. It means, for example, that the movement of a cat from a position on a couch to a spot nearer the hearth is quite unlike the sudden displacement of a stone. Second, *organic activity continues independently of the initiating impulsion.* A photoelectric cell device will detect blemishes in fabrics and cast the defective parts aside, but only on continued stimulation by the current. A girl operative will also detect and cast aside the defective parts, but she requires only one stimulation in the form of instruction from the foreman in order to carry

on the activity independently, indefinitely, and intermittently. Third, *organic behavior expresses variability of direction.* If, in the case above, the machinery should suddenly stop, the girl would seek help or undertake on her own initiative to make an adjustment, activities which no non-living device could possibly perform. Fourth, *the specific activity of an organism terminates as soon as a necessary adjustment has been effected.* A bird will cease its activity of nest-building when the nest is completed. But activity of an inorganic sort continues after the initial propulsion until deflected or stopped by the intervention of an object exerting superior force. Fifth, *organic behavior usually involves preparation for new activity.* There is a connectedness about behavior which is inexplicable except in reference to some goal or purpose. Sixth, *repetition of organic activity often effects improvement of that activity, that is, growth in adjustment.* A machine may become smoother in operation, but it cannot be said to *grow* in effectiveness, in the sense that a child grows or improves as he learns longer and harder piano compositions. Seventh, *organic behavior is characterized by purpose.* The behavior of a bird, for example, in battering itself against the interior side of a window, cannot be understood without reference to the purpose of escape.[1]

These identifiable criteria of behavior appear not only to observation of a casual sort but also to observation experimentally controlled. They signify that organisms cannot be explained as mere automata subject only to the laws of motion of the inorganic realm, but that explanations must be sought in terms of organized response, in terms of purpose or goal activity, and in terms of insightful adaptation.

That is to say, learning is an organized response in so

[1] The author is indebted to Professor McDougall's account of the "Marks of Behavior" (23).

far as it exhibits the character of unified or patterned wholeness. For example, the child's learning of a sentence is of a patterned whole rather than of separate alphabetical bits. Learning also implies purpose or goal in so far as it is always directed toward some attainment. Again, learning involves insight, inasmuch as the activity is discriminative or meaningful in opposition to the action of "blind" automatism. For the term insight expresses just that tendency on the part of an animal or human being to note details of a situation in relation to the whole of an environmental setting and to adjust accordingly.

HOW ANIMALS LEARN

The ensuing survey of the experimental evidence upon the nature of learning will cover representative cases of organisms having a central nervous system, with the exception of the first-mentioned.

Paramecia and amoebae.—Experiments with tiny one-celled animals—paramecia and amoebae—appear to demonstrate capacity for modifiability on the part of these animals, though no positive proof is available that the modifications are essentially discriminative. In one of these experiments a paramecium was enclosed in a capillary tube small enough to prevent the animal from turning round. An obstruction was placed in the tube in such a way that the animal in swimming would collide with it, reverse its cilia, and then go forward again. Repeated reversals of movement seemed to the observers to indicate an avoidance reaction on the part of the animal, a reaction which it retained when returned to the tube after having been allowed to swim about freely (7).

Experiments with amoebae lead some investigators to suppose that these organisms are also capable of learning. These animals are negatively phototropic, that is, avoid light, so that when a beam of light is thrown across

their path they first reduce the number of attempts to cross the beam and then change their course to avoid the light (8).

Earthworm learning.—Evidence of learning, of a more positive character, has been obtained from experiments with earthworms. In traversing a path, experimentally arranged, this organism not only acquires a habit of direction but learns to avoid noxious stimuli such as sandpaper, chemical solutions, and electric shocks. Observations point to the conclusion that the earthworm also learns the correct way out of a simple T-shaped maze, and further, that it *discovers the shortest way out* (40).

Goldfish learning.—Experiments with goldfish show still more conclusively that lowly organisms are capable of learning in a discriminative manner (27). For example, an aquarium is set up in which three lighted compartments, containing food, are placed (Fig. 1). Forty-two fish were taught to feed, some from the brightest compartment, some from the medium-bright compartment, and others from the dimly lighted compartment. In this particular experiment the fish made a total of 6203 choices (38).

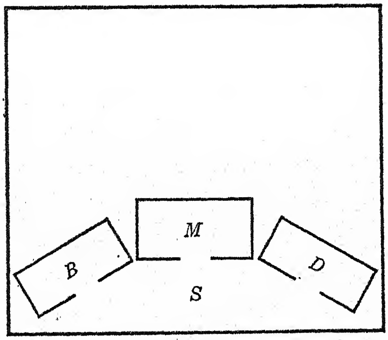

FIG. 1

S is the position of the goldfish at the beginning of each experiment. *B, M, D* signify bright, medium, and dim lights. [From Wheeler (38)]

The results showed that goldfish learn to select a particular food compartment by discriminating it from the other compartments. Even when the light intensities were increased or decreased relative to each other, and the compartments shifted about, the fish on the whole continued to discriminate with increasing accuracy.

There were individual differences of performance among the fish and for a given fish from day to day. In general, however, the experiment clearly indicated that correct response was not a matter of chance, inasmuch as *the percentage of correct responses was far above what chance would allow* (27).

The learning of chicks.—An apparatus is constructed containing seven compartments each illuminated by 100-watt lamps controlled by rheostats. Food is placed in the compartments as an incentive to learning. As in the case of the goldfish, the chicks are taught to select their food from respective compartments of a given light intensity. After the training period of ten days the intensities of the lights are changed both up and down, and the compartments transposed.

However, the chicks usually choose the correct compartment by sensing the change of conditions. And even when the situation is further complicated for the chicks by the addition of a lighted box placed in varying positions relative to the food-compartments, the chicks continued to solve the problem of locating their own compartments with a degree of success far above that of chance. Inexplicable exceptions were noted on the part of the chicks who had learned to feed from the compartment of medium intensity. For the rest, however, the percentage of successes can warrant only the inference that the chicks learn in the form of a goal activity in which a particular feature, food in relation to light intensity, is discriminated out of a total, but changing, environmental pattern (21).

The learning of white rats.—Concerning the white rat, long a favorite subject for psychological experiments, a vast amount of data upon learning has been accumulated. The experiment cited here represents an endeavor to test the discriminative ability of this animal in terms of the dominance of relative and absolute cues. A num-

ber of rats are trained to jump a distance of twenty-five centimeters to one of two openings, each of which is covered by a card bearing a design in the form of a white circle on a black ground. One of the cards represents a "positive" stimulus, the other a "negative" stimulus. Thus, whenever a rat jumped to the positive it was rewarded by food; whenever it jumped to the negative it was punished by a bump on the nose and by the shock of falling a distance of four feet into a net.

In one test the sizes of the circles were nine centimeters and six centimeters. For six of the rats the nine-centimeter circle was the positive stimulus, and the six-centimeter the negative. For six other rats the stimuli were reversed. After a practice period in which the learning was considered to have been achieved when thirty errorless responses had been made, other cards were substituted for those used for training purposes. The circles on the new cards were of the ratios of thirteen centimeters to nine, and six centimeters to four. Results of the experiment indicated quite clearly that the rats discriminated the *relative* sizes of the circles, inasmuch as they chose correctly, although the circles that were positive in the training period were now negative, and the negative, positive.

From such results as these it is evident that the white rat learns in the form of *responding to relationships and by discriminating details as belonging to a patterned whole and as involving adjustment respecting a goal* (13).

The learning of cats.—Passing to a still higher level of animal organization, one finds in experiments on the learning of cats some striking evidence of adaptive behavior. A series of such experiments has been carried on at the animal laboratory of Yale University. The following experiment is typical.

A cubical cage is constructed, three sides of which are

covered with a fine wire mesh; the fourth side is made of bars of brass tubing. A cat, placed near the cage, could view the situation clearly but could not put any of its paws through the bars or the wire mesh. Inside the cage is placed a piece of raw liver on a flat pan about eight centimeters in diameter—the sort of thing which serves as a cover for small jars of preserves—to which a string is attached. The string is made of felt weatherstrip, 210 centimeters in length, laid loosely in a right-angle form and running out of the cage. The experimenter arranged the string in this way so that it would have to be pulled somewhat before the pan would move. The diagram below illustrates the situation.

In all, eleven cats were used for this experiment. Five of them did nothing about the string. One pawed at it once and then abandoned it. Six cats successfully pulled the string and obtained the liver. With these cats, the significant point of observation is that *they invariably discovered the relation between the string and the food;* for when the lid moved on pulling the whole string to the point of tautness these cats perceived the connection of liver-to-string-to-pulling. On being placed again in the original position, some of the cats appeared to perceive the relationship immediately, for they solved the problem without any waste effort or movement. In most cases the cats learned the situation to maximum efficiency in the second or third trial. Moreover, after the experimenter had rotated the cage through an angle of 90 to 100 degrees, among the trials, the cats instantly proceeded to the solution. And sixty days later, with no

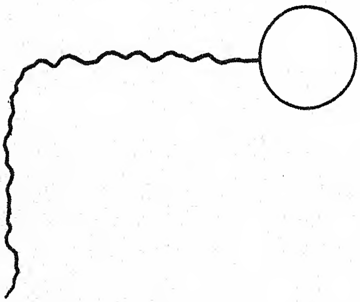

FIG. 2
[After Adams (1)]

trials intervening, each of the originally successful cats gave evidence of retention of the problem and its solution by immediately adapting to it (1).

The learning of apes.—As a final selection from the wide range of animal investigation, the work with anthropoid apes is of first-rate importance for an understanding of the psychology of learning. Much of this work has been done by two leading psychologists—Köhler of Germany and Yerkes of America. Although these men carried on their investigations in different parts of the world and independently of each other, they arrive at practically identical conclusions respecting the adaptive behavior of apes. For our purposes, the work of Köhler (17) will serve in brief illustration of experimental procedure and results.

Köhler's experiments were conducted at the Anthropoid Station on the island of Tenerife during the years 1913-1917. In one of these experiments he suspends a basket of fruit from the wire roof of a cage in such a way that by pulling of a string the basket will be made to swing in the direction of a scaffolding. The basket cannot be reached by an ape from the ground. At the appropriate moment the experimenter sets the basket swinging and then lets into the cage three apes: Chica, Grande, and Tercera. Grande attempts to reach the basket by leaping from the ground, but fails. Chica has meanwhile looked over the situation, then suddenly runs to the scaffolding and catches the basket as it swings past. Other apes similarly attain the objective.

However, for one ape, Sultan, the situation is changed somewhat. Before he is allowed to see the basket, it is made to swing in a circular motion and at a regular speed past a beam. When Sultan is brought into the cage, he gazes at the swinging basket for a moment, following it with his eyes, and as soon as it swings past the beam he leaps up there at once and catches the basket on its next

swing. Köhler varied the situation by having the basket swing near a wall, a tree, and other objects, but in each instance the animals adapted to the new situations by varying their responses accordingly.

Another problem situation consists of a cage containing several sticks placed near the bars, with fruit placed outside the cage but out of reach from the inside. A female ape, Tschego, is then let into the cage directly from her sleeping quarters. She tries to reach the fruit with her hands, but, of course, fails. For a time she alternates the activities of reaching for the fruit and lying down; then apparently takes no further interest in the fruit. Soon, however, some of the younger animals, who have been playing nearby, approach the fruit. At once Tschego leaps to her feet, grasps one of the sticks which she has heretofore seemed to ignore, puts one end of it on the farther side of the fruit, and pulls the latter within reach of her hand. This experiment was repeated with varying forms with other apes with similar success, though with individual differences of technique.

Here a pertinent question might be put to an animal psychologist as to whether or not an ape is capable of *constructive ingenuity*. Fortunately, from numerous experiments, this question can be answered positively and conclusively.

Köhler, for example, places his ape, Sultan, in a cage wherein are two hollow bamboo rods. A banana is outside the cage, but beyond the ape's reach. Sultan tries in vain to reach the banana with one or other of the sticks. He then does a number of bootless things, such as carrying a box to the bars. Finally, the ape pushes one stick through the bars as far as he can in the direction of the fruit, then takes the other stick and uses it to push the first one still nearer the banana until a contact is made. At this point the animal manifests satisfaction, though he does not secure the food. After more than an hour's

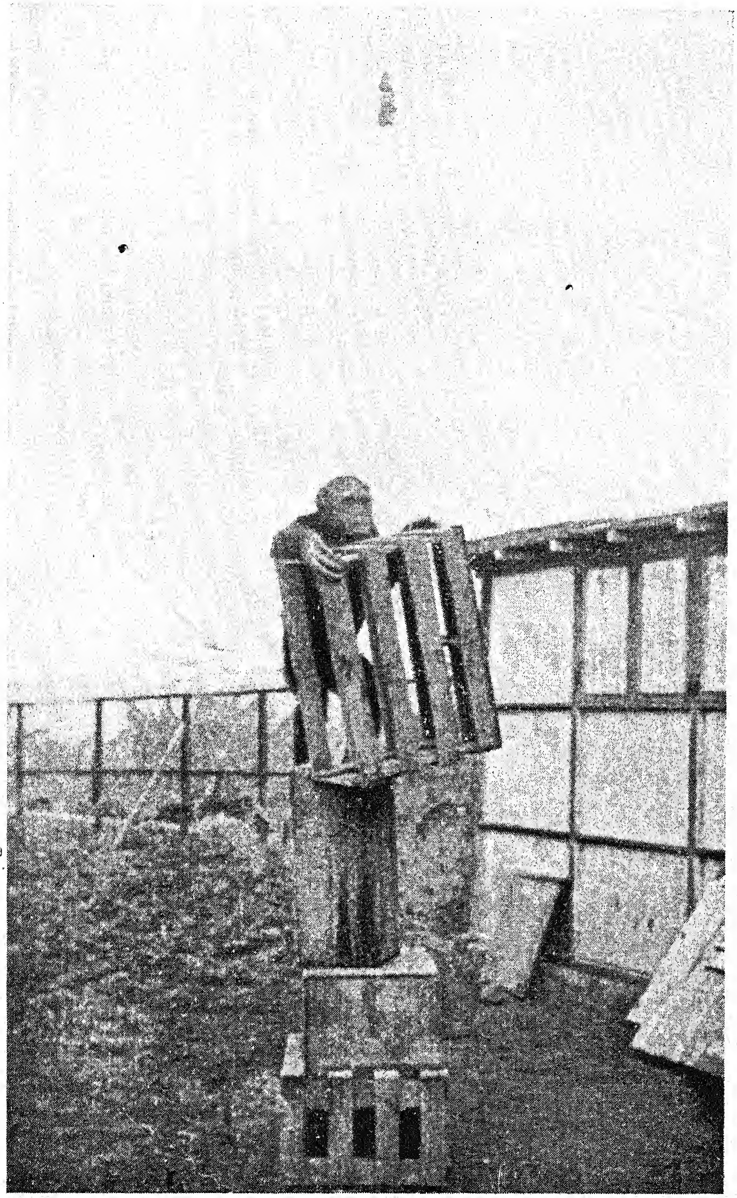

Fig. 3
Ape achieves a four-story structure. (From Köhler)

lapse of time, Sultan suddenly takes the two rods, meanwhile put back into the cage by the experimenter, and plays with them. In the course of the play the ape holds them together so as to represent a straight line and then pushes the thinner one into the other. Immediately he runs to the bars and draws in the banana with the lengthened instrument. Here, indeed, is a palpable demonstration of constructive insight.

In subsequent problems set by the experimenter, the apes gave further unequivocal evidence of discriminative, insightful adaptability. One of these problems consisted of a situation in which a suspended banana could be reached only if the animals sense the utility of boxes upon which to climb and thus secure the fruit. This utility the apes did sense. In fact, one of them dragged boxes from various parts of the compound to a spot directly under the suspended fruit and actually erected a four-story structure in order to obtain the objective (Fig. 3).

SUMMARIZED INTERPRETATION OF ANIMAL LEARNING

We may now consider the relevancy of the foregoing experiments to the purpose of interpreting behavior as learning. Of course, whether or not learning is going on can be ascertained only from observation of behavior. And the criterion of learning, here, is *achievement on the part of the the animal in meeting a new situation.* This criterion exemplifies three characteristics: organized wholeness of response, discrimination, and goal direction.

Throughout the survey of these representative experiments, one observes that within the limits of each animal's structural capacity there is positive evidence of the above-mentioned characteristics. In the case of the simpler types of organisms, earthworm, goldfish, chick, and rat, these characteristics naturally appear in a very simple, crude form. In the case of the higher types, cat

and ape, these characteristics are revealed in greater obviousness as well as elaborateness of detail.

Scientifically, one is not entitled to say from these observations that the animal "reasons through" to the solution, precisely as a human being would under comparable circumstances. Nevertheless, the conclusion appears warranted that the animal demonstrates an appropriateness of behavior which a mere chance succession of reactions could hardly achieve.

Of course, it is to be admitted that chance success and accidental connections often occur in the process of attaining the goal; however, these lucky breaks, so to speak, take on significance for the animal inasmuch as it subsequently utilizes them to gain its objective. Sultan, it was observed, apparently by sheer accident got the two bamboo rods in a straight line, and perhaps accidentally pushed the one into the other; but the immediate utilization of the lengthened rod to secure the banana was a positive and genuine act of insightful adaptation. To interpret the completed act wholly in terms of a chance concurrence of purely random movements is to exceed the limits of scientific sense. Only an obsessive interest in a preconceived theory of behavior could lead one to deny the patent fact that insightful adaptation does occur.

It is possible, of course, so to vary the details of a problem-situation, and to set up a problem, that the animal is incapable of solving it in a discriminable way, with the result that the animal fails on every trial or achieves an isolated success only by chance. But such problems are obviously unfair to the animal. Just what type of problem is suited to the level of an animal's psychobiological organization can only be ascertained through a balanced judgment on the part of an experimenter and by means of many trial situations. Manifestly, an experimenter himself would exhibit a lack of

insight if he should judge the intelligence of a child of ten upon the child's reaction to a problem in calculus.

HOW HUMAN BEINGS LEARN

On passing to a review of experiments on human learning, one at once becomes aware of an outstanding difference in learning equipment as between animal and man, namely, the equipment of language. This makes for an enormous advantage in experimentation upon learning by vastly increasing the range of problem situations. For not only may the experimenter state the problem to the human subject, in those situations where feasible, and thus secure his coöperation, but the experimenter may also obtain further enlightenment as to the nature of learning by having the subject state his own "sense of the situation," his feelings, his difficulties, his cues, and so forth. Thus the subject's introspections upon his own experience as a learner provide a really indispensable supplement to the experimenter's observations.

From the very young infant, naturally, one cannot obtain these introspections. Fortunately, however, the infant of a certain age can *respond* to verbal directions even though too young *to report* its own experience. Hence an infant of this age may very conveniently serve as a subject of experimentation in learning of a sort intermediary between ape and child.

Comparison of infant and ape learning.—The results of a unique investigation are available from which to compare the learning of a child with that of an ape of similar age (15). In this investigation the experiments included such problems as discovering the relationships of a latch to the releasing of a door and thus effecting escape; sensing the utility of objects, for example, a chair, for the securing of a cookie suspended from a ceiling; perceiving the significance of a hoe-like instru-

ment for the purpose of pulling an apple through an aperture; and solving a problem of pathways involving detours.

In some of the experiments the infant ape was slightly superior in achievement to the child; in others, the reverse; and in others, again, the one was as competent as the other. In the detour experiments, after a few successful trials, both infants spontaneously adopted short-cuts. This particular instance of ingenuity, according to the observers, "is clearly not the one which has been *most frequently* practised; instead, it involves at least in part an entirely new pathway and it is suddenly introduced at some point in the trials when it has never hitherto been made. . . . That the subjects are each able to make this new response in the same situation and so solve it completely and satisfactorily, regardless of the position of the door, may be regarded as additional evidence of insight" (15).

But unique as this investigation was, it nevertheless calls for no revamping or reconsideration of the conclusions formulated from our survey of the experiments on animals. Indeed, so far as this particular investigation was carried, a period of nine months, it tends to support those conclusions. Had it been continued over a much longer period, the child would doubtless have far outstripped the ape in adaptability, as it gave evidence of doing toward the close of the experiment. However, it is of undoubted psychological interest to observe that the characteristics of the learning were essentially the same on the part of both, and essentially similar to those of the lower animals.

Following the procedure adopted by Köhler in experimenting with apes, a study by Alpert (3) was made upon the behavior of young children. This experimenter tested forty-four pre-school children, of an age range from nineteen months to forty-nine months, with such

problems as the following: a toy balloon suspended from the ceiling to within four feet of the ground, nearby a block of wood which could be used for climbing; a similar situation but with a chair substituted for the block; and a further situation with the toy hung higher, requiring a box-chair combination to secure the toy. Again, a play pen is arranged with a stick inside and a toy outside, the problem being to recognize the stick as a tool for getting the toy. On another occasion, two halves of a fishing rod are placed inside the pen, neither of which alone will reach the toy, but which when joined together will do so.

The comparableness of these problems to those used by Köhler will be apparent. However, as noted above, the difference in the present experiments lies in the language factor. Yet, notwithstanding a difference of this sort, the study revealed that the reactions of the children bore striking resemblances to those of the apes. For example, some of the children, immediately upon entering the experimental room, attempted directly to reach the toy with the hands. Failing in this procedure, they would glance about the room, see the block and use it to reach the toy. The children, however, tended to perceive more quickly than the apes the tool significance of the block. This also is true of the sticks. But, like the apes, the children made a lot of useless movements, accompanied in several instances by outbursts of temper and signs of distress.

Aside from these similarities, the children proved superior to the apes in methods of exploration and elimination of false movements. And these are the methods which express degree of insight as a fundamental feature of learning. This insight does not always appear with suddenness, nor is it the same from individual to individual. But it is important to note, for the sake of interpretation, that efficiency in learning is a matter of quickness in seeing the pertinent details within a situa-

tion relative to the specific goal. Some children see these details almost at once, some see them gradually, and some never see them at all if left to their own devices.

Child learning.—Experiments upon children of school age have emphasized to a very great extent the language factor. The one to be cited had as its purpose the discovery as to how children learn the meaning of opposites. Here the learning involves the ability to discriminate an object, event, or other circumstance in antithetical terms, such as up-down, in-out, black-white, alive-dead, and so forth. The experiment is verbal in character, both in form of presentation and form of response. Ninety children served as subjects, all of them from the public schools of Ithaca, New York.

Results pointed to the fact that children under the age of six and one-half do not grasp the relation of opposites. A further fact appeared that those who do grasp the meaning do so with relative suddenness, that is, the meaning appears as a flash of insight. Furthermore, this type of learning is achieved once and for all. No repetition of instruction or of practice is ever necessary. Hence, this and similar studies have led psychologists to conclude that a test requiring the detection of the relation of opposites provides an invaluable means for testing intelligence (18).

Adult learning.—Passing to studies upon adult modes of learning, one finds in Snoddy's investigation of *mirror-drawing* an outstanding illustration of the reactions of mature learners to a problem situation wherein the conditions of control have been refined to an unusual degree (30).

Here the problem is to trace a double-lined star pattern, as shown in Figures 4, 5, while looking at the pattern through a mirror.

With the pattern directly in front of the mirror, his hand covered by a screen, the subject traces the star pat-

tern between the lines, taking care not to touch them. For the uninitiated, this is at first a rather difficult task, inasmuch as the image in the mirror is the reverse of the

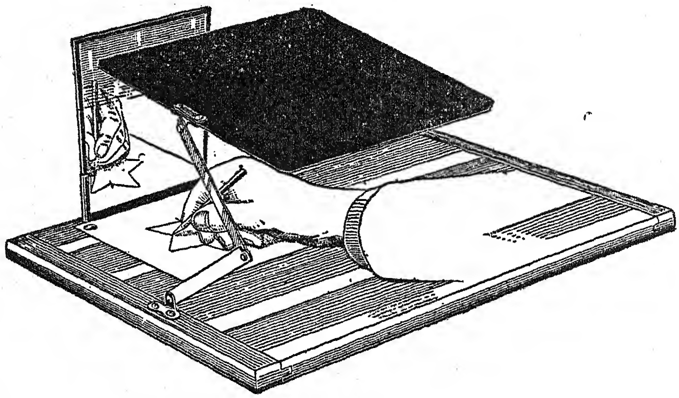

FIG. 4
(Courtesy of C. H. Stoelting Co.)

normal situation. The eye and the hand tend to take opposed directions, a circumstance that is both annoying and confusing to the subject. To trace the star successfully under this condition of reversed perspective, the subject must retrain his hand against the highly inhibitive tendency of pre-established habit. Most subjects, however, learn to trace the star with accuracy and with increasing speed after five to fifteen trials.

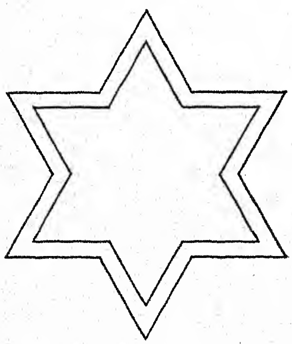

FIG. 5

To interpret the results of this sort of experiment, the introspective reports of the subjects themselves are of great importance. From these reports one discovers that the learners attained mastery of the problem by means of a single factor of control, namely, a clear visual perception of that portion of the

pattern immediately ahead of the tracing-stylus. Then, as speed increased, they tended to scan larger and larger areas of the pattern, except where an especially difficult spot was encountered, such as the turn of an angle, in which case the learners returned the focus of vision to the area immediately ahead of the stylus. Figure 6 portrays characteristic differences between the first and the fifth tracings.

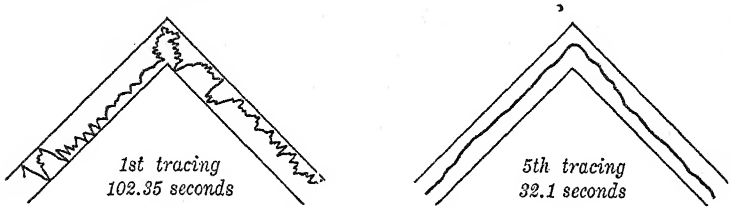

FIG. 6
[After Snoddy (30)]

Snoddy himself conceives the experiment to be a demonstration of "trial and error" learning; that is, learning achieved through a succession of *accidentally* correct movements—without any control in terms of insight. However, he noted from the reports of the subjects that the correct movements followed upon attaining a balance of muscular adjustments in the tracing arm and that this balance induced the tracing of a straight path. And the significant point is that this discovery upon the part of the learners proved to be a decided aid in the subsequent tracings.

Consequently, the experiment reveals two factors of control: the visual perception of the path ahead and the attainment of muscular balance. Both these factors develop as insightful attempts to resolve the difficulty of circumscribing the star. Otherwise, how may one account for the fact that they are recognized by the learners as influencing the tracing toward a successful end? On a mere trial-and-error basis, their recognition of these

factors would make no difference. A rightful interpretation of the results would indeed emphasize these factors as indicative of selective discrimination rather than of mere chance.

A further illustration of adult learning may be taken from an experiment in mastering Chinese characters (34).

In this experiment two objectives guided the learning: *reproduction* of the characters after learning and *recognition* of them when later presented. The tests for recognition revealed that difficulty in learning does not depend upon complexity of the characters, within the limits used for the experiment (two to twelve strokes). Tests for reproduction, however, indicated that the learning is increasingly difficult as the characters become more complex.

As for the *manner* of learning, the subjects reported that when the learning was directed for the purpose of recognition they tended to learn the characters *as a whole* rather than as separate strokes to put together; and that when directed towards reproduction they tended to learn by fixating some salient feature of the character, and then organizing the rest of the details about this one feature. In either case, the dominant characteristics of the learning proved to be of the nature of discriminating details in relation to other details of a whole.

WHAT OF INTERPRETATIONS?

Throughout the foregoing account of representative experimental studies of the nature of learning, the interpretation has followed the principles that behavior is an affair of the organism-as-a-whole. In summary, these principles (*a*) aver that organic behavior is inescapably a goal-activity, characterized by discrimination and insightful adaptability, and (*b*) imply a denial that such behavior is adequately explicable as a mechanical com-

position of structural units or as a chance concurrence of isolable factors.

In contrast, one should inquire what a mechanical interpretation of the experiments would be. A mechanical interpretation, as previously noted, confines itself to the structural type of analysis whereby a whole of any sort is seen as a composite of parts. By the method of introspection the so-called structuralist determines the parts as elements of conscious mind, namely, sensations, images, and feelings. By the method of the conditioned reflex the behaviorist determines the parts as neuromuscular reflexes. Whichever method is used, then, the inference is that learning effects are produced by mechanics of association whereby parts somehow come together to form wholes.

The introspectionist view.—As far as this interpretation is concerned, it could only pertain to the learning activities of the adult human being. For by virtue of its definition of psychology as the science of consciousness and of its utilization of the method of introspective analysis, it has nothing to offer by way of explanation of learning as a *process of adjustment to environment.* Hence it excludes from its domain all problems of animal and of child learning; obviously, for animals and children cannot introspect.

So, the only account of learning that it could give would have to be in terms of an associative process whereby elements come together to compose a given experience (28). To illustrate: One would learn to recognize a cat, let us say, by building up in consciousness a complex pattern of sensory elements, etc., as these are evoked by stimuli—visual sensations (color), touch sensations (feel of fur), auditory sensations (mewing), olfactory sensations (odor), and so forth. For the assumption underlying this type of explanation is that experience is basically of this atomistic character, the idea

of "cat" being a compounding of sensory bits by some law of association.

Yet these elements, as such, cannot ever be directly experienced. Hence they cannot be legitimately evoked to explain the total object perceived (4). One apprehends the cat as a *whole* cat to begin with, never as a composite of sensations. Besides, the analytic procedure of this type of psychology is, as we have noted, essentially artificial and abstract, and therefore cannot be of any real value in aiding understanding of the learning activity. For learning is always concrete; it is an activity of the individual as a whole, an activity which structural analysis destroys. By this analysis one finds oneself studying something other than *the* learning. As one critic puts the matter, "This whole industry of analysis is a quest for 'unconscious consciousness'" and hence leads us nowhere (4). For this reason, the introspectionist interpretation of learning has largely been abandoned by contemporary psychology.

The behaviorist view.—On turning to behaviorism for its account of learning, one really exchanges one type of mechanism for another. It is a fact of historical significance that behaviorism, as a distinctive scheme of psychological interpretation, emerged from studies upon the behavior of animals (39). These studies had their antecedents in the researches of Russian physiologists, of whom Pavlov is best known and from whom the behaviorists adopted the principle of the conditioned reflex (14).

This principle implies the mechanistic assumption that *all learning, whether of animals or human beings, is purely a matter of associating reflexes.* In the view of behaviorism, some of the reflexes are native; that is, they function under appropriate stimulation before any learning has occurred. For example, it is well known that a new-born infant's hand will grasp any object, such as a

pencil or finger, when placed upon the infant's palm. This reaction, called the "grasping reflex," is a relatively simple neuromuscular unit of behavior, symbolized in psychological literature as $S \rightarrow R$. In the above instance the S (stimulus) is the contact of the pencil or finger with the palm, the R (response) is the closure of the hand.

Pavlov, in his animal laboratory, found that he could "condition" dogs to secrete saliva at the sound of a buzzer. Normally, of course, an animal or human being secretes saliva at the sight or odor of food, in which case we say that the food stimulates the salivary glands. Pavlov, however, discovered by frequent presentations of food at the sound of a buzzer that eventually the animal will secrete saliva on hearing the buzzer, even though no food is presented. This is the classic instance of the "conditioning of a reflex" (11, 26). And, as noted above, it was studies of this sort which furnished the foundation for the behavioristic theory of learning.

This theory is really quite simple. Given the fund of native reflexes,[2] the process of learning becomes just the process of connecting specific stimuli with specific responses. Frequency of repetition fixes the $S \mapsto R$ combinations into habits. Moreover, each R becomes an S to a further R, thus forming *chains of reflexes* which, in turn, become relatively fixed as habit systems. Hence, from this scheme, a case of learning is just a series of conditioned reflexes. The process is accordingly utterly mechanical, requiring no insight whatsoever on the part of the learner (35). Indeed, for behaviorism, insight itself must either be a reflex process or nothing at all.

It follows, then, that every one of the investigations cited in this chapter would be interpreted by the behaviorist in terms of mechanisms of reflexes (36, 37). To be sure, increasing complexity of organic structure

[2] See Watson's *Behaviorism*, Ch. 6.

makes for an increasing range of responses. But throughout the entire scale of animal and human learning, the simple $S \rightarrow R$ mechanism provides the key for the unlocking of the mysteries of behavior. What some psychologists call evidence of insightful adaptability the adherent of the behaviorist theory would interpret as accidental success.

Thorndike (31, 12) has performed extensive experiments upon fish, chickens, cats, dogs, monkeys, and human beings, and in all of them he professes the mechanistic doctrine of part linked to part in a purely chance manner. In his experiments with cats, to cite but one instance, he constructed a puzzle box in such a manner that escape from it could be effected by operating one of several devices; turning a button, pulling a string, pressing down a lever, or by pulling on a wire loop. A hungry cat is placed inside the box and stimulated to seek a means of escape by the sight and odor of a morsel of fish or meat placed just outside the box. Naturally, the cat manifests a great deal of activity: clawing, pushing, nosing about, mewing, trying to squeeze through the openings, gazing about, and making other "disconnected" or "random" movements. Finally, the cat accidentally pushes the button or pulls on the loop, the door opens, and the cat escapes. With repeated experiments, the cat gradually reduces the number of "waste" movements and escapes more quickly, until, after twenty or more sessions, the cat directly releases itself by a prompt attack upon the appropriate releasing mechanism.

And this sort of procedure leads Thorndike to conclude: "Here we have the most widespread sort of learning in the world. There need be no reasoning, no process of inference or comparison; there need be no thinking about things, no putting two and two together; there need be no ideas—the animal may not think of the box or of the food or of the act that he is to perform. What

we surely know is that he comes after the learning to do a certain thing in certain circumstances which before the learning he did not do in those same circumstances. . . . This purely associative learning by trial and success to respond in this, that, and the other way to situations directly presented to sense is the same in its general nature from the minnow to man" (31).

Some critical comments.—Of course, the question as to whether or not animals "think about things" or "have ideas" is a question of definition of terms. Certainly one has no right to attribute to an animal those capacities or characteristics which ordinarily are considered peculiarly human. If by "thinking" one means what for the human being is *verbalization* then the animal does not think. If, however, one means that the animal somehow discriminates details of a situation in relation to other details of that situation, and acts accordingly, then one may characterize *that* activity as a sort of thinking. And it is this latter sense of the term which numerous psychologists adhere to in their interpretation of animal learning as embodying the aspect of insight.

Moreover, the type of experimental set-up devised by Thorndike has been criticized as quite unfair to the animal (2, 16). Doubtless, if a human being were to be placed in a comparable situation, he, too, would grope blindly about in an attempt to escape. But he would succeed in escaping relatively quickly only because he has grown up in an environment that has initiated him to bolts, buttons, strings, and latches. How, then, could a cat be expected to make other than "accidental" escapes, in view of the unnatural situation for the animal, a situation involving releasing devices that are such only on the human level of development? Certainly, the animal exhibits a stupid fumbling about, *but fumbling only as measured by human standards of performance.*

It is possible to reinterpret the so-called trial-and-error,

or chance-success, behavior in terms of *orienting oneself to a difficult situation.* Any *new* situation that confronts an animal or human being calls forth more or less of fumbling just because it *is* new. But the solution or eventual success may just as well be regarded as a developing insight as an accidental connecting of $S \rightarrow R$ bonds. Indeed, as will appear, the insight hypothesis is far more plausible than that of chance success. And although Thorndike regards insight and trial-and-error as incompatible hypotheses, he does so only because he interprets the latter mechanistically as a piecemeal connecting of S and R according to chance. But they are not really incompatible when trial-and-error is seen to be the orienting activity of an organism placed in a strange situation.

Furthermore, in denying insight and goal-activity to animals, as well as to human beings, the mechanistic hypothesis fails to account for *relevance* of response. To put the matter in the form of a question: How does the successful response come to be repeated and so learned? Thorndike's answer is that the successful connection is repeated because it "satisfies" the animal or human being; a wrong or unsuccessful response is not repeated because it "annoys." But this sort of explanation appears dubious when one calls to mind those instances of behavior which persist in spite of annoying effects.

From animal experimentation it has been shown that rats will cross a "live" electric grill in order to secure food or a mate (25). And when one recalls how men will go through "fire and water" or face continued defeat in some enterprise, it is hard to see how annoyance prevents repetition of response. Such behavior can be explained only by reference to some goal. Indeed, Thorndike practically admits this when he states: "To run when nature moves is satisfying, but to get from this place or to that place, or nearer that animal, or ahead of this man, is

commonly the larger satisfier in instinctive responses of flight and pursuit" (32). In bringing in the notion of a "larger satisfier," he tacitly admits the inadequacy of the theory of particular satisfiers and annoyers, which the mechanistic conception must logically hold upon its own interpretative scheme of behavior as $S \mapsto R$ connections.

Again, the conditioned-reflex theory is inadequate when applied to cases of "negative practice." To illustrate: A person learning to operate a typewriter frequently makes errors of a rather persistent sort, such as transposition of letters of a word—*hte* for *the.* But there is evidence to show that *by exercise of the wrong response the error can be eliminated; that is, by actually typing "hte" one will learn to type correctly "the."* Cases of this sort call in question the simple $S \mapsto R$ theorem inasmuch as the connections exercised are not the ones learned. The fact of this "negative practice" becomes explicable in terms of insightful conception of the problem at issue (9).

In these as in other cases of learning, one has to recognize the fact of *selection of response* and the fact also of *selection of stimuli.* These facts are inevitably tied up with *goal-seeking.* And, apart from this relationship of selectivity to goal-seeking, the organism will *reject* certain responses when these do not facilitate attainment of the goal. Neither the animal nor the man will pay attention to those features of the environment which the one or the other sees as not relevant to the activity of the moment. In a sense, of course, the animal and the man do attend to such features but in a negative way, that is, as something to ignore. Even in the most apparent cases of "random" behavior, there is selection and there is rejection with a view to the relevant (33). A satiated cat will ignore the pungent odor of a morsel of fish. A man will ignore the ringing telephone in his neighbor's house.

Moreover, there is evidence from experiments with animals which directly challenge and cast doubt upon mechanistic principles. For example, a rat that has learned to release itself from a cage by numerous repetitions of pushing the latch with its *paw,* suddenly releases itself by pushing the latch with its *snout,* a response not at all previously utilized and for which obviously there can be no established $S \rightarrow R$ connections (24). And it has already been noted how even very simple organisms will select the shorter of two alternate pathways, an activity which can only be accounted for on a hypothesis that admits the possibility of discriminative adaptability.

But a much more crucial type of experiment appears in those cases where rats, after having learned the pathway of a maze, were subjected to operative removal of sections of brain-substance (20). In these cases it was discovered that no matter what area of the brain was removed, the rats still solved the problem of running the maze. To quote Lashley, who conducted these experiments: "The evidence from many lines of investigation opposes interpretation of learning as the formation of definite 'conditioned-reflex arcs' through the cerebral hemispheres or through any part of the nervous system." "The behavior shows a responsiveness to relationships and a unity which is difficult to express in terms of simple conditioning" (19).

In view of these experimental data, the conclusion has been drawn that behaviorism has erected a scheme of interpretation of learning for which genuine scientific evidence, physiological or psychological, is lacking (6, 29). It has mistaken its own allegorical construction for a real mechanism of behavior (10). It has operated upon the assumption that to be scientific the study of behavior should follow an atomistic conception of the living organism whereby even functional wholes, as instanced in learning, are to be explained in terms of a

quantitative analysis of structural elements. This assumption, consequently, has led to an assiduous concern with those aspects of behavior which appear amenable to precise—though essentially abstract—measurements, such as energy units of stimulus and concomitant amplitude of response. And this concern led to the ignoring of those organic conditions which could not thus be measured—state of hunger, intensity of sexual desire, influences of surroundings, and so forth—but which cannot be ruled out or even ignored in any explanation that would be true to the facts.

Logically, a mechanistic interpretation of learning has earmarks of inconsistency. It tends to regard the organism as so much plastic material that behaves only as prodded by stimuli, and at the same time as being capable of a sort of spontaneous activity towards an objective. Besides, the mechanists do not hesitate to talk about "right" and "wrong" responses, implying, of course, a standard of judgment. But, one may ask, for whom is the response right or wrong? To be sure, it is the observer. Yet on mechanistic principles the observer himself must have been *conditioned* to say "right" or "wrong," responses which must exhibit no insight and which are to be understood without reference to any purpose whatsoever. In short, one would have to conclude from this theory that an $S \rightarrow R$ connection passes judgment upon other $S \rightarrow R$ connections and by reference to a criterion of efficiency which in turn is itself an $S \rightarrow R$ connection. Thus, pushed to the limit of its own implications, the theory disintegrates into a *reductio ad absurdum* (5, 22).

SUMMARY OF THE CHAPTER

The present chapter has been devoted to a consideration of the essential characteristics of learning as these are exhibited through experimental studies upon the be-

havior of animals and human beings in their adjustments to new situations. The delineation of these characteristics has necessarily taken a theoretical course for the plain reason that any set of data needs to be organized in terms of a scheme of interpretation. All facts, as noted in the previous chapter, point towards some hypothesis, whether implicitly or explicitly. In the present discussion, some leading hypotheses of contemporary psychology have been outlined in some detail as they involve facts of learning. On the one hand, learning is interpreted in terms of mechanical formation of stimulus-response connections. On the other hand, learning is conceived as a function of the organism-as-a-whole whose essential features are dynamic unity and insightful adaptability.

QUESTIONS FOR DISCUSSION

1. How would a mechanistic hypothesis interpret the *distinctive signs* of behavior?
2. Point out the relationship between discrimination and chance success.
3. What is involved in a *crucial* experiment on learning so far as rival hypotheses are concerned? Illustrate.
4. Is the concept of "insight" superfluous in the interpretation of animal learning? Why, or why not?
5. Why might a test of opposites be valuable as a test of intelligence?
6. What relationships do you note between the two types of learning, mirror tracing and Chinese characters?
7. Elucidate the point that introspective analysis is a "quest for unconscious consciousness."
8. What is trial-and-error learning? Would you agree that Thorndike's interpretation of learning is adequate? Why, or why not?
9. Show what is involved in "negative practice." What other examples could you offer? Is this fact of negative practice crucial for the interpretation of learning? How? Why?
10. What is meant by the reference to an "allegorical construction"? Why *allegorical?*

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CHAPTER IV

HOW TO LEARN EFFECTIVELY

ONE of the chief concerns of a student, and of others for that matter, is the improvement of his ability to learn. This concern often manifests itself in such questions as: "How can I strengthen my memory?" "What can I do to increase my speed of learning?" "Is it possible for one to learn *anything* that one may wish to learn?" Upon these and similar questions a significant amount of experimental data is available.

It should be remarked that in any popular usage of concepts like memory, intelligence, and imagination there is an insidious tendency to hypostasize them; that is, to treat them as entities, whereas they are never more than intellectual devices for *describing* the facts of observation and for arranging these facts into rough classes for convenience of enumeration and explanation. But doubtless our language forms encourage this tendency; for it is hard to interpret such expressions as, say, "transfer of energy" except as a transfer of a "something," despite centuries of education in physics. Concerning psychology, it is quite illegitimate to attempt to explain learning by reference to "a memory" that may be conceived as "good" or "bad."

Strictly speaking, the question is one of *memories* rather than a memory. Every instance of learning is in a sense a memory. Of necessity, however, psychology still uses the term memory, if only to be understood. But if one understands it as purely descriptive, one need not lapse into unscientific explanations. Scientific ex-

planations, to repeat, pertain to a complex of conditioning factors, not to some single entity. To elucidate these factors in respect to effective learning is the aim of this chapter.

LEARNING AS REMEMBERING

In the previous chapter, we saw that *retention* was an essential of learning. Psychologically, retention simply denotes the "carry-over" effect of previous adjustments by the individual in meeting a present situation.[1] But retention is not to be identified with remembering, for obviously one remembers far less than one retains. One may not remember the binomial theorem, but that it is somehow retained becomes evident when one picks up one's old algebra book and discovers that one can relearn this theorem much more quickly than one did originally. Nor is *recall* synonymous with remembering. One may recall a name or date for which one can find no memory context. Only as one *recalls with recognition* may one be said to remember (9).

The above considerations are important for the simple reason that the whole problem of effective learning involves the questions of *what* should be learned and *how* to guarantee retention of what is being learned. In other words, one's procedure of learning in any situation will depend upon whether one is aiming towards retention of knowledge as a sort of background of information that remains more or less indistinct or towards retention as an immediately available stock of facts at one's finger tips, so to speak.

Some experimental techniques.—Turning now to the experimental evidence as to the characteristics of remembering, one finds that an enormous mass of data has accumulated during the past half century. Naturally

[1] Nothing whatever is known of retention in physiological terms; that is, as to what physicochemical changes occur in the neuromuscular mechanisms of the body (8).

this would be so in view of the great practical importance of the question of retention in educational procedures. For if psychology as a new science could provide some experimentally validated suggestions as to the improvement of learning such suggestions would not go unheeded.

Ebbinghaus's methods and results.—It is to the pioneer efforts of Herman Ebbinghaus (1850-1909) that psychology is indebted for an experimental attack upon the problem of remembering. His method consisted in learning numerous lists of three-letter syllables called nonsense syllables; for example, *nof, cem, ler, zud,* to the point of recalling without aid. This type of material Ebbinghaus believed would fulfill three scientific requirements for experimenting upon memory: *pure learning material,* that is, material having no associative meanings that might facilitate recall; *equality of difficulty,* so that no one syllable would stand out as more or less easy to learn; and *convenience as units of measurement* (11).

To determine the efficiency of recall, Ebbinghaus took note of the following factors: the number of repetitions required to learn a given list to complete mastery in the form of one correct reproduction without prompting; the number of trials required to relearn a list after a certain interval of time, comparing this number with the original number of trials; and the time saved in relearning a list after intervals of varying length.

From extensive and painstaking studies, Ebbinghaus concluded that efficiency of recall is definitely related to time; or, to put his conclusions in terms of *forgetting,* he found that the percentage of loss of material varies with lapse of time, the relatively greater amount vanishing in the shorter intervals after learning, with a proportionately diminishing loss as intervals lengthen. And similarly with meaningful materials, such as selections from prose and poetry, the decrease in recall is inversely

proportionate to lapse of time, though the tendency towards loss is less great with meaningful than with non-meaningful material. Figure 7 presents comparative curves for both types of material.

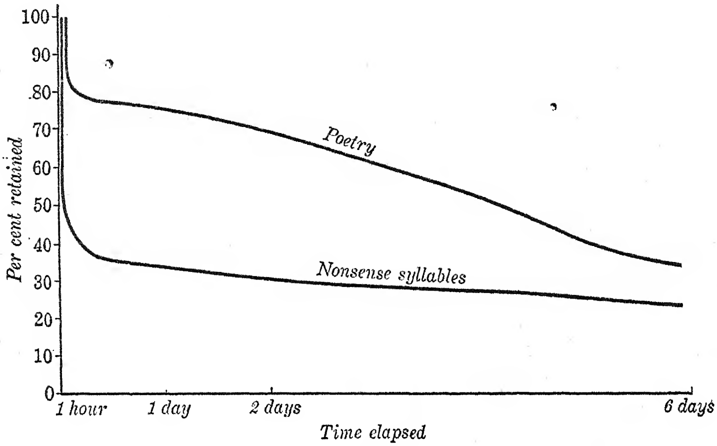

FIG. 7
Curve of retention. (After Ebbinghaus)

Although the experimental work subsequent to that of Ebbinghaus reveals numerous exceptions to the precise character of the curves as given above, doubtless on account of the variety of conditions under which experiments have been conducted, the general trend of this work appears to support Ebbinghaus's conclusions. Yet one should not infer that decrease in efficiency of recall is *solely* a function of time. For many factors, difficult to isolate and control, have an influence in diminishing recall. It is known, for example, that such diverse conditions as time of day in which the learning occurs, interpolated activities, change of interest, brain injuries, and so forth, do affect retentiveness in varying degrees, on various sorts of materials, and with different individuals. Indeed, the problem of ascertaining all the conditions which bear upon a given instance, whether of remember-

ing or of forgetting, is so intricate as to appear quite baffling.

The problem of conditions.—Even the learning of a list of nonsense syllables is no simple matter. For any case of learning inevitably occurs in a setting, whether a laboratory, a study, or a schoolroom. And as one learns the precise material at hand, one also incidentally learns the background, the "set-up," the temperature, the illumination, one's physiological state, and other possible details, all of which may appear innocently negligible but which may be quite potent either as aids or as hindrances. In fact, it often turns out that in the actual learning of specific material one is also learning *how to learn.* Consequently, any curves or series of curves, may conceal more than they reveal.

Such considerations point unmistakably to the configurative aspect of remembering. *It is relationships that count.* Even a list of nonsense syllables, ostensibly without meaning, will be learned according to some principle of organization—spatial arrangement, background, analogies, rhyme, jingle, and so on. Hence, in learning anything whatsoever, whether for purposes of experimentation or not, one simply cannot divest oneself of conditioning factors, either of past experience or of present surroundings.

The problem of type of material.—So far, the type of learning material discussed has been of the character of verbal knowledge. But what of learning in the form of motor skills? Are such skills as typing, riding a bicycle, golfing, playing the piano, better or more poorly retained than such material as mathematical formulas, foreign languages, historical events? Experimental data upon this question are at present too meager to warrant a conclusive answer. However, pertinent studies appear to show no superiority of one type over the other. One investigator, for example, tested his retention of ability

to typewrite after an interval of three and one-half years. In this instance, the original learning was acquired in about thirty hours of practice and to a degree of proficiency of twenty-five words per minute. On retesting after the interval, he wrote a fraction over eighteen words per minute. Then, after five hours of relearning, he attained a score practically the same as the one that had originally taken thirty hours to achieve (33).

Common observation, however, leads one to recognize that motor skills as a rule are better retained than verbal knowledge, doubtless because the former ordinarily receive a greater amount of practice, accompanied by a keener motivating interest, than is the case with much verbal material. Furthermore, the motor skill has a better chance of being retained because, if developed at all, it is very likely utilized as an integral feature of daily activity. But there are numerous exceptions. So far as the basic facts of learning are concerned, there appear to be no essential differences between verbal knowledge and motor skills. At any rate, classification here is bound to be somewhat arbitrary, and may be justified only in the interest of emphasis.

WAYS TO OFFSET FORGETTING

The experiments thus far cited imply two generalizations: that retention, in the sense of ability to reproduce material learned, suffers markedly at first, and less markedly as time goes on; and that meaningfulness of the material learned tends to reduce the loss in retention. With these generalizations in view, the problem of increasing one's effectiveness as a learner becomes, to a considerable degree, the problem of how to offset the initial losses in retention and thereby the subsequent losses.

The influence of distributed practice.—From a multitude of experiments on the learning of various types of

material, psychologists have concluded that one vital method of offsetting forgetting is that of distributing the practice periods. Stated in general terms, this means that if one wishes permanently to retain some material of knowledge or some process of skill, one must spread one's efforts over a relatively long stretch of practice intervals.

For complete retention.—A notable experiment by Lyon aimed to determine which of two methods of learning prose was the more effective: the continuous method, by which the material was learned at one sitting, or the once-per-day method. For this experiment Lyon utilized material from the writings of Schopenhauer, Spencer, Hugo, and Ingersoll. By the continuous method, he memorized 1200 words in 202 minutes. By the once-per-day method, he memorized the same number of words in 186 minutes, at the rate of six minutes per reading for thirty-one daily readings. Thus, in *total time spent*, neither method carries a decided advantage over the other. However, according to Lyon, when one considers *permanency of retention*, the once-per-day method is far superior to the continuous method. And the same is true in the learning of poetry (18).

Similar results have been obtained by the use of nonsense syllables (15). Ordinarily, of course, no one would wish to learn lists of nonsense syllables for permanency of retention. It would appear, however, that even retention of these is favored by distributing the practice. Ebbinghaus discovered that after a lapse of twenty-four hours the number of repetitions needed for relearning a given series could be reduced about half when the series was learned once per day for three days, as against a single learning on one day (15). And Boring has shown that the same number of repetitions will effect an increased retention of an average of thirteen per cent when

the repetitions are distributed than when they are not (3).

For amount retained.—But the method of distribution not only facilitates retention, or offsets forgetting, but also makes possible an increased amount of material learned within a given period of time. The following experiment illustrates the varying results in amount learned by means of varying methods of distribution.

Starch had forty-two students learn to associate numbers with alphabetical letters. He divided the students into four practice groups. Group I worked ten minutes

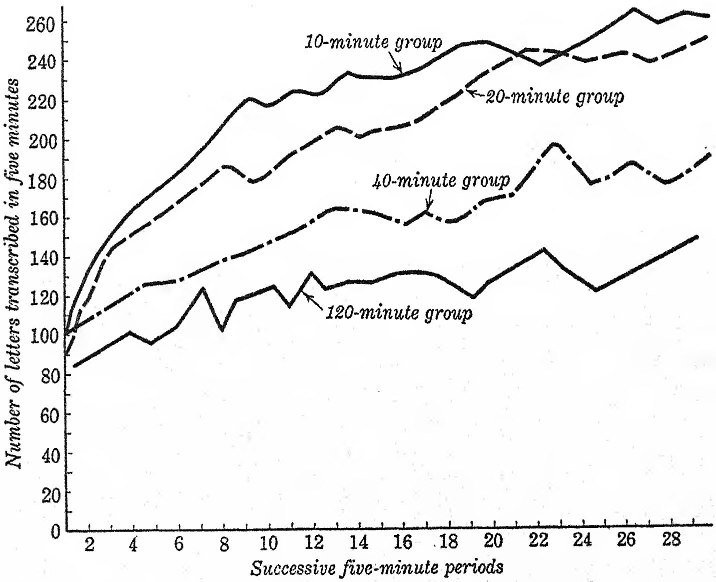

FIG. 8
(After Starch)

at a sitting, twice a day for six days, with a five-hour interval between the sittings on each day. Group II worked twenty minutes at a sitting, once a day for six days. Group III practiced forty minutes at a time, every other day for six days. Group IV practiced the

total time of 120 minutes at a single sitting. Each group therefore practiced an equal number of minutes but in varying periods of distribution. Comparative results are strikingly portrayed in the graph on page 97 (31).

From a glance at this graph it will be apparent that learning of the type cited in the experiment can be markedly facilitated by means of greater frequency of spaced practice periods. It should be especially noted that the least efficient method is the continuous, or all-at-once, method. Similar results obtain in experiments on typewriting (26).

Practical considerations.—From any sampling of experimental data, it should be distinctly understood that hasty generalizations are quite unwarranted. The results of a given experiment apply solely to the specific material used, as well as to the precise conditions under which the particular experiment is performed. One may not, for example, determine on the basis of Starch's results that one should learn history assignments in ten-minute intervals. Nevertheless, from the evidence available, it is a warrantable inference that the history will be better retained, other things being equal, if the learning periods follow some scheme of distribution.

To obtain reliable experimental guidance as to length of practice periods and frequency of practice periods over a given stretch of time would require extensive investigations upon every sort of learning material, under all sorts of conditions, and with all sorts of learners. Such a program of experimentation is doubtless beyond possibility of fulfillment. Accordingly, we are left to formulate but a tentative and general conclusion on the basis of the data at hand. And this conclusion is that *retention of material will be greater when practice periods are distributed.*

But again, no two materials—whether of knowledge or of skill—are alike. No two learners are alike. And the

same learner is not in precisely identical condition at any two periods of learning. Many subtle factors, internal and external, influence the learning efficiency at any moment. And these factors may easily be overlooked because they are subtle. Hence any experimenter would be rash to ignore them in interpreting his results and in suggesting a program of learning for any individual. For individual differences of adaptability to different lengths of study periods and intervals of rest must be recognized. And such differences are to be specified by previous training on a given subject-matter, by age of the learner, by his relative maturity aside from mere age, by his nervous or emotional stability, by his own attitudes of self-confidence, and so forth. Moreover, it may turn out that the practice period itself needs to be varied from the initial stages of learning to the later—as to length, amount, or difficulty of the material.

As is well known, an all too common procedure in learning, especially of verbal material—history, literature, newspaper articles—is to pass through the material in a more or less casual manner, as one in a canoe glides along a stream, without great concern as to whether or not one will need to return to the previous stages for purposes of rechecking or examination. And doubtless because of this casual manner, the retention of the material diminishes considerably. Indeed, it has been estimated that in about a year after the completion of numerous college courses, the actual material retained is from four to six per cent; in two years from two to three per cent; and in five years there will be little more knowledge on the part of those who took a particular course than of those who did not (21). These figures, granted their approximation to the truth, illustrate afresh the gossamer character of a great deal of verbal learning as contrasted with motor skills.

Lyon has suggested that if one is interested in per-

manency of retention of any specific material, one should adopt a scheme of practice periods approximating a *geometric ratio* (18). For example, if strict memorization is desired, the relearning should take place within one hour, again after two hours, the next after four hours, followed by intervals of eight, sixteen, thirty-two hours, and so on, until one finds the material is retained as indelibly as one's name.

If, however, one desires to retain "substance" or the "main ideas," one should review after four hours, then after eight or ten hours, followed by increasingly wide intervals of one day, three days, one week, two weeks, one month, and so on. But in view of the fact that courses of study progress from topic to topic, an excellent scheme would be to review rather intensively the topic just preceding the one to be studied, and less intensively the topics successively prior. In this way, cumulative relearning will occur with little apparent effort and with little chance of some one topic being overlearned at the expense of other topics equally important.

Then, too, *constant utilization* of the material of learning is an indispensable means of insuring retention. This is very obvious in the case of those skills which form the very fabric, so to speak, of one's daily activities, vocational or avocational. But it is no less obvious in the case of items of learning that are deemed more or less extraneous to daily activities. Such items to be retained, whether of foreign language, historical events, economic principles, or of literary or scientific information, must be integrated somehow in daily thought and action. Otherwise, they are doomed to decay.

The influence of over-practice.—It is possible to learn too strenuously and so to defeat one's efforts at retention. In this regard the most familiar case is doubtless that of cramming. Here one attempts to do too much in too short a period of time with the result that oneself as well

as one's learning suffers disorganization. This effect of disorganization is technically known as *irradiation*. Physiologically, it expresses a disorganization of energy patterns by virtue of which one temporarily loses the ability to coördinate one's efforts towards an effective grasp of the material. Psychologically, it expresses states of nervousness, staleness, and fatigue.

Irradiation effects.—As an effect of too-prolonged or too-concentrated practice, irradiation is characteristically a *negative* condition of learning. Experimentally, it has been observed to occur whenever learners sense a failure to improve despite protracted study without intervals of rest, and whenever muscular tensions develop as a result of excitement due to apprehension of possible failure. It is almost always, therefore, symptomatic of excess.

Thus, the student who persists in cramming for an examination incurs not only the risk of irradiation in the form of nervousness but in the form also of a "mental fade-out" at the crucial moment. In fact, he stands to lose all the knowledge thus gained because of its very flimsiness and confusedness. And the effect of too much drill upon various materials, without regard to the level of the learner's insight or type of emotional make-up, is fraught with likelihood of irradiation. Nor is it wise for a student to "stick it out" with a problem which threatens to consume much time and energy with a possible ending in fruitlessness, notwithstanding the implied challenge to one's ability. A wiser way would be to go to bed or to occupy oneself with other matters for a time, then to resume the attack upon the problem with greater chance of success. But whatever the circumstance, one need not tilt at windmills to convince oneself of one's courage or prowess.

It is conceivable that "nervous breakdowns" are really cases of large-scale irradiation (39). A too-intense concern for some circumstance, present or anticipated, may

effect a disintegration of neuromuscular patterns as instanced in the uncoördinated behavior of a person in hysterics. As regards learning, at any rate, irradiation represents a psychological illustration of the "law of diminishing returns," the effect of which, at the least, is to retard progress in mastery. Hence, to prevent this condition, the learner must intersperse periods of work with periods of rest, relaxation, or varied activity.

The plateau.—If one should chart from day to day one's progress in the learning of some subject like German or algebra, the resulting curve would likely reveal stages of no progress. Such a stage is called a plateau, indicated on the curve as a trend of horizontality. Figure 9 illustrates one of these trends or stages in the learning of a telegraphic code (5).

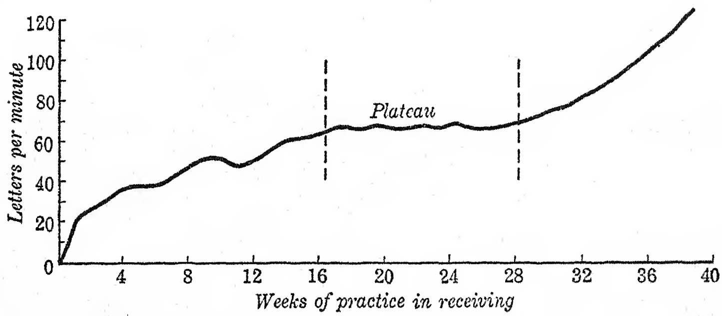

FIG. 9
(After Bryan and Harter)

In general, the conditions which produce irradiation are also determinants of the plateau. Other contributory factors are insufficient incentive, inadequate methods of guidance or instruction, temporary physical conditions, and unusually difficult sections of the material of learning. In any case, the plateau is indicative of some interference, which, when removed, results in a steady rise of the learning curve.

Learning by wholes and by parts.—Another way of offsetting forgetting pertains to mastery of material in terms of wholes versus in terms of parts. As ordinarily stated, these terms are highly ambiguous, and a great deal of confusion has accordingly developed on the part of both pupils and teachers. The problem here is not quite the same as that involved in the theoretical questions of functional and structural analysis, though there are comparable features; it concerns rather the relative amounts of material to be learned as a given assignment, the problem, that is, of learning the assignment piecemeal or as a whole.

Logical and psychological units.—But again, the meaning of a whole in contrast with a part is a quite relative matter. A part is often, in one sense, a whole. Consequently, the problem really becomes one of *logical* as well as *psychological* organization of the units to be learned. Logically, the problem concerns *meaningfulness* of the units. Psychologically, the very meaningfulness of the units is related to the *individual differences* of learners in terms of age and maturity, previous knowledge, keenness of insight, and type of aptitude, as in the case of method of distribution of practice. Obviously, an Einstein could grasp the wholeness of a mathematical plan which for a novice would need to be split up into a myriad lesser wholes, each to be mastered separately to a degree and eventually unified into the larger whole.

Learning for exact reproduction.—On this problem of wholes versus parts most experimentation has involved the objective of exact memorization. In learning poetry, for example, some investigators have used the whole method and the part method in the form of halves, thirds, fourths, and so on. Thus it is possible to take units of varying length and logical relationship and to determine what saving of time might accrue by the use of one method over a different one.

Results of this sort of experimentation indicate that the longer the sections to be learned, up to 240 lines, the greater the saving in time. Specifically, the learning of sections of poetry from twenty to fifty lines effected a saving of eleven per cent over sections of five lines. Two sections of sixty lines each are learned with savings of twenty and twenty-two per cent respectively. With a section of 120 lines the saving was seventeen per cent. And for one of 240 lines, the saving was as great as twenty per cent (25).

For a variant material, one may cite an experiment upon the learning of compositions on the piano (4). Here three methods of mastery were used: whole, part, and combination. In the whole method the musical score was to be learned by playing through from beginning to end, without stopping to correct or to repeat measures where errors occurred. In the part method the score was divided into units and each unit practiced an equal number of times. In the combination method the score was played from beginning to end, but all measures where errors occurred were repeated an equal number of times. The selections were grouped on the basis of difficulty.

Again, the whole method proved to be distinctly superior, both to part and combination methods, the part method being the least efficient of the three. But whether or not the whole method should therefore be applied to every type of composition is a question of moment. Musical scores, like other types of material, contain unusually difficult sections and also vary considerably in length. But before considering this question, it would be well to note that the distinctive value of this particular experiment lies in its close relationship to an actual life situation. Hence it may be regarded as a crucial test of the relative effectiveness of the whole method in so far as it duplicates the task to be performed.

For the objective of piano instruction and learning is the playing of the score through from beginning to end in one continuous flow.

Consequently, the success of the learning as a complex pattern of behavior requires the establishment of effective relationships of the numerous details—reading the score, fingering, pedaling, shading of tone, etc.—in such a manner that the whole pattern develops as a sequence of coördination.

Now logical consideration of the part method shows this method to defeat the objective inasmuch as it establishes *other* relationships than those required; for example, the connecting of the movements at the end of any measure, except the final measure, with the beginning of that measure. The same is true of the part method in learning poetry. Thus one can understand how a performer or a reader gets "stuck" partway through a composition and either fails to go on or fumbles around in order to reëstablish the correct relations, both of the parts to each other and to the whole. Barring the factor of "nervousness," one may yet prevent such an embarrassing outcome by assiduously keeping in view the meaningful character of the whole.

The progressive part method.—Although a great many experiments point to the whole method as the most efficient, there are nevertheless exceptions (15). Some appear to favor what is called the "progressive part" method (24). In this the learning proceeds by dividing the material into sections, the learner mastering section one, then section two, then sections one and two together, then section three, then one, two, and three, and so on. It is really a cumulative review method and proves very effective with certain types of complex material. But other experiments lead to the conclusion that there is no absolute superiority of one method over another. Others, again, show that the whole method

is generally most effective with the most intelligent learners.

Meaningfulness the guiding factor.—From this conflicting data, what is one to conclude for practical purposes in guiding the learning activity? Obviously, one cannot stop learning while the psychologists pursue experimentation in the hope of attaining a decisive solution.

For practical guidance one needs to look to the logic of the particular situation. Since learning is essentially the forming of patterns that are intrinsically meaningful, then it would appear that any selection of a unit of material should be determined primarily on the basis of its meaningfulness as a configurative whole. Whether the material be of the type of motor skills—driving an automobile, golf, typing, piano-playing—or of the type more purely verbal—mathematics, philosophy—the principle of meaningful units should be applied; *meaningful, that is, from the point of view or level of insight of the learner.* Wholes, then, that are too large or too difficult for the direct grasp of the particular learner, should be divided into sub-wholes, but never at the sacrifice of the meaningfulness of the whole.

The influence of recitation.—The effect of recitation, as a means of offsetting forgetting, has primarily to do with purposeful organization of subject-matter. Motivation enters in too.

To illustrate experimentally, it has been found that when children learn with a view to reciting, their retention of material is conspicuously increased. Indeed, after an interval of three or four hours, the effect of recitation is *four times* that of mere reading (13). And the same is true of adults (29). The advantages of recitation follow from these facts: first, it furnishes additional practice; second, it tends to increase retention by augmenting self-confidence; third, it makes for greater availability of knowledge through increase of material retained; and

fourth, it promotes organization through its tendency towards summarization (13).

It is evident, then, that the learner who is anxious to profit from his hours of study will find a distinct advantage from reciting as against merely reading. Of course, one should understand "reciting" to include any form of vocal reproduction of the material studied, whether to teachers, to friends, to associates, or even to oneself; and either formally, or in casual conversation, or in deliberate discussion. Note-taking, also, is a form of reciting and is of especial value when one undertakes to put the material into one's own words. Psychologically, indeed, it is worthy of note that he who would learn must also teach.

Again, for effective recall, experiments show that the number of readings of a given assignment must be at least *four*, and may need to be eight (29). Some persons improve their retention by adopting a scheme of periodic silent recalls. In this connection, it is said that the great historian Macaulay acquired the habit of closing a book at the end of each page and forcing himself to recall the substance of what he had read in that page. Such a habit is of undoubted psychological value.

The influence of like and unlike materials.—Learning, as usually conducted under the regulatory conditions of school curricula, comprises many kinds of subject-matter—linguistic, verbal, computative, manipulative—presented to the pupil upon some scheme of rotation. Whatever the particular scheme, it presents a problem of psychological efficiency, the problem, namely, as to what effect upon retention studies have on each other. This problem is often referred to as *retroactive inhibition*.

One may state the problem concretely. Suppose a student has been working on Latin translation for an hour or so and then turns to the study of economics; would the effect of preoccupation with the Latin constitute an interference with his learning of economics, or

would the immediate occupation with economics tend to obliterate from retention a large part of the Latin? Thus stated, the problem has both a backward and a forward reference, and may involve any sort of material that follows or precedes some different material, or is interpolated between periods of the learning of material of an identical sort.

Despite the fact of its pertinence to everyday life, this problem of retroactive inhibition is far from solution. Experimental studies are both meager and ambiguous. Some show that similarity of material decreases retention through interference; others show that similarity increases retention; and still other studies show that dissimilarity tends to favor retention (7, 14, 27, 28).

Notwithstanding the inconclusiveness of the studies to date, they do offer suggestions that are of practical value. In the first place, *thoroughness of the learning of a given material will tend to counteract interference from the immediate subsequent learning of material of a different sort.* The better grasp one gets of one's Latin assignment the less likely will be the loss by turning to a non-Latin subject. In the second place, *the length of time intervening between practice periods of similar material tends directly and proportionately to diminish recall.* This time factor has already been noted to be of prime importance in all studies of remembering, and is often signalized in terms of a *law of disuse.* In the third place, *the level of intelligence of the learner is a factor.* The brighter the pupil, the more readily he perceives likenesses and differences among various subjects and within the same subject, and the less easily does he confuse them. No doubt an individual of high intelligence could take two beginning languages, for example, without appreciable retroactive inhibition.

The influence of attitude and incentive.—One of the most vital conditions of learning is the attitude of the

learner himself. In fact, so vital is it that one may well doubt whether learning would occur at all under conditions of unfavorable attitude. And the reason for this becomes apparent when one recalls the significance of goal activity for motivating behavior.

Attitude, then, is a term which denotes those internal conditions of the organism—*urge, drive, motive, desire, feeling-tone*—essentially general and vague in character as they may be, which are nevertheless influential as conditions of effective learning; conditions, again, which depend upon some goal. But what the particular goal is for a particular individual depends upon certain other conditions, such as satiety, need for food, need for companionship, escape from confinement, desire for a position, and so forth.

How goals function.—Where there is no evident urge or drive to action, as indicated by an attitude of indifference, the chances are that no goal is present of a sort that affects the individual. Teachers and parents are often driven to exasperation over the supine indifference which characterizes certain individuals when confronted with a task of learning. Doubtless there are goals a-plenty so far as the teacher and parent are concerned. But from the viewpoint of the pupil the goal set before him is ineffective because it is too artificial, too meaningless, or for some reason undesired.

Perhaps most goals, in early years at least, are imposed upon the learner. However, the real difficulty is not so much the fact that the goal is imposed as the *manner* of its imposition. Every one of us needs guidance toward goals in the form of ideals, and such goals are, at an early age, necessarily imposed. But if the goal is distasteful, or the manner of imposing it goes "against the grain," the results are apt to be disastrous so far as the particular learning is concerned. Perhaps no clearer evidence of all this can be seen than in the traditional method of drill

in the public schools. Such drills, conducted without regard for the pupil's level of insight or interest, prove relatively of little good on the score of retention.

The problem, then, is to make the goals function for the pupil so as to induce action on his part.

In this connection, one may consider the use of the recitation as an instrument of motivation. Here, the recitation functions as a goal in a very specific manner. Both experience and experiment show that a pupil's learning activity takes on a much more positive character when he knows that he may be called upon to express himself, whether orally or in writing, as to the material studied. Here, too, may be seen the effectiveness of frequent examinations. For examinations, judiciously interspersed throughout the learning of a given course, not only stimulate the learner to more intense action but also increase the chances for retentivity.

Tangibility and significance.—An investigation upon the problem of motivation, conducted in the public schools of New York, proves conclusively the effectiveness of goals that are tangible and significant to the individual. Specifically, this investigation sought to discover the relative effects upon usage of good English of such methods as (*a*) unmotivated drill, (*b*) practice with knowledge of results, and (*c*) appeals of an imaginary sort in the form of descriptive situations where good English is an asset, as in securing a position. The results clearly revealed that pupils who were kept informed of their progress made significant gains over those not so informed. Opportunity to participate in a radio contest proved a far greater incentive than the imagined representation of a position the obtaining of which depended upon a knowledge and use of good English (32).

It has been demonstrated also that pupils under some concrete type of motivation increase their productivity tremendously. In an experiment upon school children

of an average age of eleven years, the effect of anticipation of a chocolate bar as a reward for solving problems in arithmetic was an average increase in problems solved of fifty-two per cent (17).

And from industry, similar results have been obtained. For example, at the Lakeside Press in Chicago, a psychological study by Kitson of the effects of a bonus as well as knowledge of one's daily record demonstrated that production could be increased on an average from fifty-eight to ninety-seven per cent. In fact, within a few weeks, a compositor of twenty-seven years' experience augmented his record by 142 per cent (2). While this illustration may not be one of learning, strictly speaking, it is nevertheless pertinent to a discussion of the stimulating effect of tangible incentives.

Praise versus reproof.—Motivation by praise and by reproof is known to be a very common practice in human relationships. But many who use these types of motivation for purposes of stimulating others to greater achievement may do so upon no clearly understood psychological grounds. Their methods, therefore, are apt to be hazardous. Of course, a wide background of successful experience in dealing with human beings does provide a fairly accurate basis for knowing when and to whom to apply praise, and when and to whom to administer reproof. In all such applications, however, one should take account of individual differences. It may be true that one can catch more flies with sugar than with vinegar, but in the influencing of human beings it may turn out on occasion that a judicious use of "vinegar" will prove more effective as a stimulant than "sugar." And this consideration does not necessarily lend support to the time-worn principle that "to spare the rod is to spoil the child." For neither commendation nor sarcasm, reward nor punishment, has absolute value for purposes of motivation.

This viewpoint is borne out by experiment. In the public schools of New York City, 408 children were tested in respect to influence upon achievement of praise and reproof. All the children were given an intelligence test. A week later they were divided into three groups for purposes of taking a second form of the same test; this time, however, under differing psychological conditions. Group I, the control group, took this second test under standard conditions; that is, no remarks were made except those concerning the directions. Group II, before taking the second test, were praised very highly for their work on the previous test and were encouraged on this occasion to exceed their previous scores. Group III were severely criticized and condemned for their showing on the first test and were given no encouragement for the second.

Using the control group results as a basis for comparison, the other groups performed as follows: thirty-seven per cent of the boys did better by praise and forty-four per cent by reproof; fifteen per cent of the girls improved by praise, and eleven per cent by reproof. Thus it would appear that praise and reproof are about equal in incentive value. However, the boys seemed to respond better than the girls, and the superior children better than the inferior. Apparently, the inferior children tend to work more nearly to their capacity than is the case with the superior children. And the same is probably true of the girls in comparison with the boys (16). And not only are the results true of children in the grades; they apply with similar cogency to college groups (2).

Practical considerations.—Thus, from a brief sampling of varied experiments upon the effects of incentives, one becomes impressed by the enormous potency of motivation when used in concrete form. Indeed, the whole vast range of psychological investigations presents no

demonstrable facts of greater weight than those obtained in experiments upon incentives. Yet even a casual survey of current methods of teaching and learning leaves one with the feeling that these facts, important as they are, remain largely unapplied, if not totally unknown.

The implication of all this should be fully recognized; namely, that the operation of incentive cannot simply be assumed because learning is *ostensibly* going on. The incentive needs to be made real in such a manner that both the goal itself and the learning become definitely related to each other through initial clarification in terms of purpose and in terms of pupil insight. Otherwise the learning is very likely to be disorganized, desultory, and fruitless, at least so far as the goal intended by the teacher or the parent is concerned.

Inevitably, as a fundamental feature of behavior itself, the activity of the learner will be directed toward some goal. But what the goal in particular will be depends upon the individual's insight and interest. When one considers the enormous output of energy and time devoted to such inane objectives as the championship of tree-sitters, flag-pole climbers, and marathon dancers, as well as to the positively anti-social goals of delinquent and criminal behavior, one can more readily appreciate the necessity for a thorough psychological understanding and utilization of motivation socially desirable, yet, for the particular learner, effective.

After all, despite the possible shock to one's idealistic sentiments, *effective teaching follows upon a clear recognition of what pupils really are rather than upon what one thinks they ought to be.* Such appeals as to emulate the lives of the saints, to "be good because Jesus wants you to be," to master quadratic equations because hard work develops moral fiber, to memorize French idioms because "you may want to be a diplomat some day," are the sort of appeals that pertain to remote and intangible

goals, and that consequently are more likely to leave pupils "cold" than to evoke effective coördination of effort. So long as teachers fail to appreciate those elements of a situation to which *the pupil* is most sensitive and by which *he* or *she* is most incited, just so long will they fail to stimulate the pupil to strive for goals of an increasingly higher type.

And it does no good to castigate the pupil for his seeming waywardness, or to hurl imprecations upon him for his "low" ideals. In calling such ideals "low," one is presuming a standard of judgment which lies outside the pupil's range of clear comprehension. For, psychologically, as soon as a "higher" ideal or goal is sensed by the pupil to be of value as an object or position to achieve, the pupil therewith feels an urge toward that goal. Accordingly, one may now see why, in the matter of improving conduct, a great deal of preaching has always been inevitably, because psychologically, futile. No one needs to be goaded to learn or to improve. Attraction, rather than compulsion, is the true psychological method. And all this becomes fully recognized upon realization that a real goal, by its very nature, is always compelling.

Feeling-tone.—As a further aspect of motivation one should consider the rôle of feeling-tone; that is, the pleasantness or unpleasantness which attach to, or develop during, a given learning activity. Common observation tells us that for the most part we tend to persist in those activities which induce feelings of satisfaction and to avoid those which result in annoyance or unpleasantness. Thorndike, as was noted before, has elevated these two feelings into terms of a law of learning called the "law of effect" which maintains that satisfyingness reinforces and annoyingness inhibits learning (34).

At first glance one might incline to agree that the law is valid, despite the criticisms previously made. Here,

however, one should inquire whether the particular feeling of pleasantness, let us say, pertains to the experience of the activity itself, or whether it rather pertains to the objective or goal. Of course, if the feeling does refer to the activity itself, one may still conclude that the goal in this case is the obtaining of the pleasurable activity and nothing more. If, then, one should contend that all action is for the sake of having pleasant feelings, one would virtually be subscribing to the *hedonistic* theory of learning, a full discussion of which would take us beyond psychology into ethics. At the same time, feeling-tone is a condition of learning and hence demands consideration.

In the form of reward and punishment, these two feelings of pleasantness and unpleasantness have received some attention in relation to praise and reproof. A few paragraphs earlier we noted how significantly the simple reward of a chocolate bar intensified the learning activity of school children. Punishment, too, may on occasion promote learning when judiciously applied as a means of preventing errors. And even the *fear* of punishment may induce effective learning (16). However, as concerns the effect of an unpleasant feeling, it holds no invariability either negatively or positively. A pupil may really learn material that for him is quite distasteful at the time of the learning; and he retains this material because it facilitates achievement of his goal. It is to the *goal,* then, that pleasantness or unpleasantness become attached as determinants of learning, rather than to the *mere activity* of the learning.

And these considerations prove of immense importance in respect to the possible influence of false goals. The arithmetic may be learned not so much for the values accruing from a knowledge of arithmetic as for the possession of the chocolate bar. The Latin may get translated only under the parental compulsion which makes

fulfillment of the task a prerequisite for permission to play baseball; in which case the ostensible goal of appreciating Latin literature recedes into the proverbial realm of good intentions or else is renounced altogether. Again, it is a question of tangibility of goal. Practically any curricular subject is susceptible of presentation in terms of a concrete goal, vocational and avocational. And the problem for the teacher and parent is primarily one of ingenuity in transmuting the intangible and abstract into the tangible and concrete. When that is done the vexatious indirectness of the pupil's attitude toward many of the things he ought to learn will of itself change into the commendable attitude of directness.

It is often claimed, by the psychoanalysts for example, that one tends to forget unpleasant experiences and to remember only the pleasant ones. If this is true it would naturally have an immense bearing upon learning. To test the validity of this claim a number of studies have been made, of which the following is typical.

On the day following a Christmas vacation a group of 132 college students were asked to describe all their experiences that could be recalled as having occurred during the vacation, and to designate them as pleasant or unpleasant according to a scale of vividness from most vivid to least vivid. Six weeks later, without warning, the procedure was repeated. On the first test, the total experiences recalled were 2231. Of these, 1393 (62.4%) had been marked pleasant; 838 (37.3%) unpleasant. The second test showed that 1092 (48.9%) had been forgotten during the six-week interval. Of these experiences originally designated pleasant, 593 (42%) had been forgotten; and of the original unpleasant experiences, 499 (59.5%) failed of recall (19).

Although the percentage of loss in the case of unpleasant experiences is somewhat greater than for pleasant ones, the difference is really too small to be significant.

And it is quite possible that a different group of individuals would reveal opposite results. In fact, other studies do lead to opposite results (6). Hence one must conclude that it is not the simple fact of an experience being attended by the one feeling or the other that makes for retentiveness or its opposite, but that it is a question of goal relationship. In other words, one tends to forget an unpleasant experience if it does not accord with the particular interest dominant at the moment; and one tends to remember those experiences which do so accord.

LEARNING FOR THE SAKE OF TRANSFER VALUES

The problem of transfer presents the question as to what effect, if any, the learning of one type of material has upon a different type. Here the question is not so much one of retroactive inhibition as of educational values. One might wish to know, for example, whether the study of Latin will inculcate a habit of accuracy which would carry over to quite diverse activities. Or, one might wish to know whether training in mathematics will enable one to formulate sound conclusions upon legal, philosophical, or social questions.

This problem of transfer has been subjected to extensive experimental study but not in every case with dependable conclusions. However, before assessing these conclusions, it would be well for us to survey a few of the more reliable experiments.

Transfer of motor skills.—For motor skills the problem is to determine whether or not the training of one restricted group of muscles would have any beneficial effect upon a different group. To illustrate, in the mirror-drawing experiment mentioned in the preceding chapter, it can be demonstrated that the training of the right hand in tracing a star pattern does somehow effect an improvement in the unpracticed left hand. With some subjects, after fifty to one hundred trials with the right

hand, the left, or unused, hand gains in improvement as much as sixty-five per cent in both speed and accuracy (12).

Another experiment upon motor skill may be cited. This made use of a cup-and-ball apparatus. A 10.5-centimeter wooden handle was constructed with a wooden cup at the end, shaped so as to contain snugly a round wooden ball. The ball weighs four grams and hangs at the end of a fine cord twenty-five centimeters long. The other end of the cord is attached to the wooden handle below the cup. "When the handle is held loosely between thumb and fingers, an adequate manipulation will enable the subject to flip the ball into the air. A further adjustment, if adequately carried out, leads the ball into the cup. Without previous practice the task is an extremely difficult one; but facility is gained rapidly by most subjects. Manipulation of the apparatus may lead, in each trial, to one of four results. The ball may bounce into the cup and stay there; it may fall into the cup and bounce out again before the subject can gain control of its movements; it may merely hit the cup, or it may miss the cup altogether." For each of these responses, scores were given respectively of 3 points, 2 points, 1 point, and 0.

All the subjects were right-handed and had had no previous experience with the apparatus. Dividing them into two groups, one for training, the other for control, the practice was as follows:

Training Group
50 trials with the left hand
500 trials with the right hand
50 trials with the left hand

Control Group
50 trials with the left hand
Rest period of 45-60 minutes
50 trials with the left hand

The results for the training group showed an average improvement for the left hand of 61.1% and for the control group an average improvement of 28.5%. Thus the amount of transfer can be stated in terms of percentage of improvement as 32.6% (20).

These experiments, and numerous others of a similar character, prove beyond question the fact of transfer in the case of motor skills. And they tend to support the organismic hypothesis of learning; for obviously the improvement of the unpracticed hand must be due to some condition that reflects the dynamic nature of the organism as a whole. On the mechanistic assumption that learning is a process of building up reflexes, there could occur no improvement for the unpracticed hand, for no $S \rightarrow R$ connections with this hand have been established.

Transfer of verbal skills.—Turning, now, to those problems of transfer which pertain to verbal knowledge, one does not find in the experimental data such clear demonstrable conclusiveness as in cases involving more purely motor skills. To be sure, a great deal of experimenting has been done upon verbal material, but the conclusions derived therefrom are often of a conflicting character; a circumstance attributable in part to the complexity of the factors involved. When one undertakes, for example, to test the influence of training in mathematics upon other learning activities, one must proceed to isolate this influence from all other possible influences. And it is very doubtful if this can be altogether successfully done. But in view of the fact that this sort of transfer is commonly assumed to occur from one curricular subject to another, it would be highly desirable to test, as far as possible, the validity of the assumption.

A typical experiment to determine whether students who have had a semester of Latin are better reasoners than those who have had no Latin may be cited as fol-

lows: A large group of students were selected from four different high schools on the basis of approximate equality of intelligence (as determined by a standard intelligence test) and on the basis of Latin and non-Latin training. The students were paired (214 pairs) on this basis of training and given a series of reasoning tests comprising arithmetic, history, sociology, and economics, these tests being arranged on a scale of difficulty.

From the results it was found that no really significant differences stood out to distinguish the one group from the other. In terms of the difficulty scale it was seen that 115 Latin students did better than 115 non-Latin students, and that 98 non-Latin students exceeded 98 Latin students. Put in percentages, fifty-four per cent of the Latin-trained students were superior in reasoning as compared with forty-six per cent of those who had had no Latin. In both groups, however, there appeared striking individual differences (30). From such data as this experiment exhibits one may infer that the mere fact of having been subjected to training in Latin for one semester cannot account for reasoning ability in such materials as the test presented. Otherwise, the percentage in favor of the Latin-trained students should have been much greater.

Thorndike has conducted a much more extensive investigation on the relative values of high-school studies for improving intellectual ability. In May, 1922, he gave an intelligence test to 8564 pupils who were in grades 9, 10, and 11. A year later he gave an equivalent test to these pupils, and then correlated the gains made on this second test with the pupils' achievement in studies taken during the year. Thus it was possible to record what influence, if any, a particular study had upon improvement of a particular ability as tested by the tests.

The details of this investigation are far too involved to report here, but the results may be summarized in

the form of an illuminative quotation from Thorndike's conclusions. "If our inquiry had been carried out by a psychologist from Mars, who knew nothing of theories of mental discipline, and simply tried to answer the question, 'What are the amounts of influence of age, sex, race, amount of ability, and studies taken, upon the gains made during the year in power to think, or intellect, or whatever our stock intelligence tests measure,' he might dismiss 'studies taken' with the comment, 'The differences are so small and the unreliabilities are relatively so large that this factor seems unimportant.' The one causal factor which he would be sure was at work would be the intellect already existent. Those who have the most to begin with gain the most during the year. Whatever studies they take will seem to produce large gains in intellect."

On the basis of this investigation Thorndike presents an "order of values" of curricular studies: (1) arithmetic and bookkeeping, (2) physical science, (3) algebra and geometry, (4) Latin and French, (5) physical training, (6) social science, (7) history, music, and shopwork, Spanish, English, drawing, and business, (8) dramatic art, cooking, sewing, and stenography, (9) biological science. The location of this last-named study must not be taken without the qualification that the tests contained no items pertaining to living things.

Thorndike concludes that a study in itself has little, if any, value as a means of *improving* intellect. He remarks: "When the good thinkers studied Greek and Latin, these studies seemed to make good thinking. Now that the good thinkers study physics and trigonometry, these seem to make good thinkers. If the abler pupils should all study physical education and dramatic art, these subjects would seem to make good thinkers." And he further reminds his readers that these last two subjects constituted the important materials of the curric-

ulum of the ancient Athenians, whose reputation for thinking has never waned (36).

Transfer of learning methods.—Not only does the problem of transfer relate to materials of study but also to *methods* of study. Here, again, as in the case of the traditional subjects of the curriculum such as Latin and mathematics, there has been, and still is, a widely held assumption that special training in methods carries over to a variety of non-related situations. This assumption operates to a considerable degree, for example, in the teaching of laboratory sciences. That a particular student will ever have a practical need for the knowledge acquired or presented in a course, say chemistry, is often regarded as a matter of minor concern; what is of concern, so it is said, is the training he receives in accurate attention to details, in searching rigorously for facts, in impartial estimating of evidence, and in detecting and eliminating bias in the forming of conclusions. Hence it is a question of moment as to whether or not this sort of training actually does prove effective in situations of human interest that are more or less remote from the sciences, as, for example, in estimating the qualifications of a candidate for the presidency.

From a list of experimental studies upon this aspect of transfer it appears that no guarantee whatsoever can be given as to the carry-over possibilities of routine practice in situations which differ from those of the original practice (38). Habits of neatness, for example, acquired in relation to drawing exercises do not automatically apply in the writing of themes. Still, it has been demonstrated that by *adequate instruction,* transfer effects may occur from one type of situation to another type widely different. In short, when instruction takes the form of emphasizing *principles* applicable to differing situations, transfer is more likely to take place.

This sort of instruction shows up its value through

experiment. One investigator used 182 university students as subjects in an experiment to find out whether or not instruction was of any consequence in methods of memorizing. The students were organized into three groups, designated *control, routine-practice,* and *training.* All three groups were given memory tests, both at the beginning and at the end of the training periods. The materials used for these tests comprised poetry, rote prose, factual items of information, a Turkish-English vocabulary, historical dates, and a series of consonants. The control group received no practice and no instruction in memorization and thus served as a test group with which the other two groups could be compared for transfer effects. The routine-practice group memorized poetry and nonsense syllables without any instruction in methods or principles. The training group, in contrast, was definitely instructed in efficient methods of memorization, such as learning by wholes, by schemes of grouping, and so forth. For each of the two practice groups the learning periods were 177 minutes in length, twice a day for four weeks. Comparable scores were obtained for the initial and final tests in terms of *time required* for memorizing selections of poetry and prose, and in terms of *number of items correctly recalled* for the other materials.

In ascertaining the transfer effects on the basis of gains on the final test as compared with the initial test, it was noted that the control group achieved practically no transfer, the routine-practice group a slight transfer, and the training group a very marked transfer. To cite typical results: In memorization of dates the gains for the control group were 2.2, for the routine-practice group 2.7, and for the training group 5.7; in memorization of the Turkish-English vocabulary, there was a loss for the control group of 0.1, a gain for the routine-practice group of 0.5, and a gain for the training group of 7.5 (41).

Transfer in relation to disciplinary studies.—This whole question of transfer has a great deal to do by implication with the structure of a curriculum. Traditionally, the underlying assumption of educational theory and practice reflected a psychological view that the mind was divisible into separate areas and functions called "faculties"—"reason," "will," "memory," and others, terms familiar to every one. Moreover, these "faculties" were supposed by certain persons called *phrenologists* to be manifested on the exterior of the skull in the form of "bumps." But since the rise of experimental psychology and experimental neurology, this view has been discarded by reputable scientists. Yet this notion of faculties still persists as a naïve belief of the common man and of the antiquated educationist. Witness current advertisements for courses in "mind-training."

In the present connection it will be of interest to observe how this old notion became the psychological framework for the classical type of curriculum whose contents were predominantly Latin, Greek, and mathematics. For these subjects were held to be preëminently suited as means of cultivating the imagination, building up the will, strengthening the memory, and sharpening the reason. Moreover, they were hard subjects as any schoolboy will testify; and their very quality of hardness constituted a prime justification for their use in developing intellectual and moral character. Accordingly, they came to be known as "disciplinary" studies, and the theory of education which made these subjects the very foundation of training came to be designated the theory of "formal discipline."

When, therefore, the experiments on transfer appeared to lead to conclusions which challenged the curricular supremacy of these subjects, a great deal of acrimonious discussion eventuated among educators as to what a vital curriculum should contain. On this point, suffice it to

say that in recent years the trend in curricular reform has taken a decided turn against the notion of formal discipline. Whether or not the experimental work on transfer has initially been responsible for this reform remains a moot question.

What conclusions may we draw?—In formulating conclusions upon the issue of transfer, one is bound to recognize again the enormous complexity of the problem itself. Indeed, had this complexity been fully appreciated by psychologists as well as by those who championed the cause of formal discipline, there would have been no occasion for the dissemination of those unfounded claims that have clouded the entire question of educational theory and practice (35, 37).

On the one hand we find the unfounded assumptions of "die-hard" advocates of general mental discipline, and on the other hand the unwarranted generalizations of investigators who drew facile conclusions from highly inconclusive data. Hence the cause of cultural education has been needlessly weakened and seriously handicapped by insistence upon untenable claims, and the scientific prestige of some investigators has suffered on account of their proneness toward hasty inferences.

The complexity of the problem turns mainly upon the difficulty of control. For, as we noted above, it is practically impossible to isolate any instance of learning to the extent that no intruding element whatsoever could enter to complicate the situation and thus to render interpretation equivocal. Specifically, no experimental technique can eliminate the effects of previous training. Even though the material to be learned for *experimental* purposes appears quite new to the learner—as, for instance, Esperanto—yet it is *new* only in a quite relative sense. One already possesses some verbal facility, at least as a background of training, which indeed makes a difference in the manner of apprehending the "new."

But precisely what the difference is, in kind or in extent, no one can determine.

One should therefore state that in view of the present status of the experimental investigation of transfer, any conclusion, positive or negative, can be taken only as tentative. A great deal of further experimenting needs to be undertaken upon all sorts of subject-matter and with many groups of individuals. At all events, thus far one may be reasonably sure of a number of inferences which appear warranted by the evidence and which may serve as points of guidance.

The first of these points is that *transfer cannot be taken for granted as automatically occurring from one type of learning to another, or from one situation to another.* One is not entitled to infer that the development of accuracy in translation of foreign languages will necessarily cause a person to be accurate in reporting his neighbor's opinions on religion or politics.

The second point is that *instruction which lays emphasis upon principles in such a way as to lead the learner to detect these principles in varying situations and in diverse materials is more likely to induce transfer than instruction which neglects this emphasis.* The law of diminishing returns is not exclusively relevant to economics but is applicable to many situations in life.

The third point stresses the factor of intelligence. *The brighter the learner, the more likely that transfer will occur.* Keenness of insight expresses itself in the quick detection of relationships of facts and principles in varying situations.

A fourth point arises from the experimental disproof of the "faculty" theory, namely, that *it is unpsychological to maintain any subject on a curriculum for disciplinary purposes.* The study of any subject can be justified only in terms of its own value as an element of culture or as a vocational asset.

A fifth point reflects the configurative view that *transfer is more likely to happen in the case of those studies which appeal to the learner as relevant to his goal.*

A sixth point reiterates the fact, observed in all experiments, that *there are significant individual differences with respect both to materials of learning and to the learners themselves.*

THE PROBLEM OF WHAT TO LEARN

This chapter has been concerned thus far with the problem of determining the methods and conditions which make for effective learning. But nothing has been said on the question of *what* to learn. This, be it noted, is a question of myriad implications, the detailed solution of which lies far beyond the scope of an introductory textbook in psychology. Nevertheless there are salient matters which do fall within our scope.

Life and the curriculum.—In the first place, the period of life devoted to the more formal aspect of learning—the school period—is relatively quite short. And, indeed, an entire life of three-score years and ten is utterly insufficient, under the most favorable economic conditions, for the acquisition of much knowledge and skill. The problem of ascertaining what to learn is accordingly inevitable and must be faced.

In the second place, within the school curriculum itself, representing as it does a selection from areas of knowledge under the guidance of contemporary social requirements, there is an immense amount of material which can never be learned by any one individual, and much of what is learned with great labor and at great expense vanishes for ever. Many students but a few years away from college appear to remember nothing more about certain courses taken than the titles. And many do not remember ever having taken studies for which they re-

ceived credit on the registrar's books and for passing which, in part, they received a degree. All of which is psychologically quite understandable.

The question arises as to whether or not a strict utilization of the effective methods and conditions as outlined in this chapter will guarantee permanency of retention of what one undertakes to learn. The answer is bound to be negative. For, as we have seen, one tends to retain only those items of knowledge which relate to one's purpose or goal. Moreover, in the case of skills—golf, piano-playing, etc.—a great deal of what has been learned in connection with the acquisition of a skill, such as instructions, details of surroundings, and temporary aids, must actually be forgotten if the skill is to function efficiently (8).

Essentials versus nonessentials.—A great deal of effort may be wasted in the attempt to remember details that not only become irrelevant to one's purposes but a positive hindrance to the achievement of those purposes. Time and energy devoted to rote memorization of historical dates, factual items of picayunish character, and trivial associations, leave little opportunity for the grasping of meanings and the development of appreciations. And many school tests place the primary emphasis upon sheer factual memorization under the delusion that verbatim reproduction is a sure sign of accomplishment. Such questions as "What does 1066 stand for?" "Who was the first governor of Kansas?" "What was the length of the first railroad in the United States?" are questions which fail utterly to develop genuine thinking upon the part of pupils, but which tend rather to produce mechanical repeaters who are motivated to learn chiefly, if not solely, to pass a test.

As far as selection of materials for learning is concerned, there is only one basis upon which to make the selection. *That basis is life's purpose.* In guiding any

learning activity the question should always be asked: Will the particular learning help the individual to meet the situations of his life better than if he omitted this specific learning?

Life, however, is both individual and social. Children must be trained to become useful members of society as well as for individual exhibitions of unique talents. Hence one must recognize the necessity for such learning materials as will facilitate citizenship or socialization. And this necessity can best be met by emphasis upon the basic instruments for acquiring knowledge and skill, that is, the mother tongue and computation (22). Beyond these, as fundamentals, the problem of selection becomes a highly individual matter and demands a thorough psychological analysis of individual aptitudes, interests, and opportunities, as these point towards the goals of life, vocational and avocational.

Furthermore, one must determine largely for oneself the essentials of learning from the nonessentials. And for this there can be no rule of thumb, no instruction as to how to differentiate the essentials; for, in the last analysis, the learner can choose only in terms of his own insight. And insight pertains to grasp of principles rather than to factual acquisition. It follows, therefore, that *in the interest of effective retention, learning should be emphatically directed toward mastery of principles.*

THEORETICAL CONSIDERATIONS

The inadequacy of a mechanistic interpretation of learning has already been pointed out. Its assumption of specific $S \rightarrow R$ connections has been called in question. However, a number of theoretical questions come into view in relation to the *nature of memory*. Even disregarding the old notion of memory as a faculty, the question *What is it?* is a persistent one. And the answer from modern psychology is that *it is not anything*. For

memory simply denotes the fact that one can recognize some, at least, of one's past experiences and can utilize these for purposes of present adjustment. As a noted psychologist expresses the matter, memory denotes the organism's ability "to turn round upon itself" (1).

Nevertheless, there is a widespread view that memory is somehow the individual's past experiences "stored up" in the form of "traces" in the nervous system, stamped in by repetition. Accordingly, for every specific experience ($S \rightarrow R$) there is a specific trace; and since these traces would be related to each other, in greater or less degree, as the experiences were related, memory would consist of associative links whereby a stimulus would revivify traces connectedly linked with that stimulus. Thus, if one should suddenly hear the word "Christmas," a whole mass of traces would revive, dependent, of course, upon individual experiences, but all brought out by the stimulus word.

Obviously, from this point of view, one must carry about with him an innumerable miscellany of traces. And, theoretically, what has once been impressed can under appropriate stimulation be revived. Conversely, nothing can be revived that has not been impressed.

But this view of memory can be shown to be inadequate. Experiments in which observers were given geometrical designs to commit to memory revealed that recall was not of a reduplicative nature, as the theory of traces would imply, but exhibited rather marked tendencies towards additions, omissions, and changes of various details *for which no impressions had been given* (1, 42).

Conceivably, the mechanistic hypothesis could apply to those reactions of the organism which are of the character of fixed habits. But a close and exhaustive scrutiny of behavior would reveal very few of these. For behavior is almost wholly a flexible, adaptable affair. Indeed, it is extremely doubtful if any activity or experience is ever

reduplicated. For one thing, growth or maturation is constantly going on, and the act or idea 'repeated' has undergone modification, and reappears, so to speak, not in identical form but as a new experience whose characteristics are a function of the present conditions. Accordingly, *remembering is more of the nature of construction than of mere reduplication* (1).

Instead of a theory of traces, a better conception of memory seems to be one which regards the process of remembering as a maintaining of "attitudes," whereby the organism deals with a present circumstance on the basis of those conditions which have served it in the past (1). These attitudes are an expression of the individual's behavior as a whole, and hence cannot be reduced to simpler aspects. Thus, one can more easily understand how selection is possible. For it is a fact of behavior that the individual "looks back" for those items in his own past which would have application to present needs of adjustment. This, again, is the fact of *relevancy*—a selecting out of the mass of experience that which is deemed appropriate for one's purpose or goal.

Besides, one can more readily understand how it is that one remembers best those items of experience which fit in with attitude, interest, or goal, *regardless of the amount of repetition* which these items have received (40). Indeed, mechanism cannot perforce utilize goals or interest in guiding learning but must, if it would remain consistent in its interpretation of learning, fall back upon methods of sheer drill so as to effect automaticity of habit (23). And in view of this patent fact of selectivity the mechanistic interpretation may turn out as a misleading guide, both as to theory and practice.

SUMMARY OF THE CHAPTER

This chapter has reviewed representative experimental studies upon methods and conditions of effective learn-

ing. These studies point to the conclusion that retention of material once learned is conditioned by a number of factors relative to methods of learning and to attitudes of the learners. One method is to distribute the learning periods at intervals depending upon the difficulty and length of assignment, and also upon the capability of the particular learner. Otherwise, irradiation is likely to occur to inhibit the learning itself. Another method is to learn in terms of logical units or wholes, on the principle that learning by parts is likely to involve disruption of the pattern of the whole and also to involve the learning of details which must later be unlearned. A further method is that of active participation in the form of recitation. In the case of school subjects, particularly, the learning may suffer interference in the form of retroactive inhibition. But this can be largely prevented by thoroughness of mastery.

As for attitudes of the learner, there is universal evidence that learning increases, both in quality and quantity, whenever the learner sees the material as pertinent to his own goals. Both praise and reproof operate effectively as incentives, though in varying degrees with different learners. Feeling-tone appears to have less significance as a condition of learning than does the goal, although it should be recognized that goal activity is itself fundamentally satisfying whenever it expresses the individual's own preference.

Upon the question of transfer of learning, the experimental evidence, except in the restricted cases of motor skills, appears ambiguous. Still, there appears justification for concluding that transfer may be effected by method of instruction and more readily on the part of the more intelligent learners.

As to what one should really undertake to learn at all, it was pointed out that this question inevitably con-

cerns the individual—his capacities, opportunities, and interests. The one universal obligation placed upon the learner is to become thoroughly familiar with the tool-subjects, as instanced in the vernacular and computation, for these are the means by which all other learning is possible. Aside from these, it would appear from all considerations of psychological import that learning directed to mastery of principles should take priority over mastery of heterogeneous factual details.

Finally, the chapter gave a brief account of diverging theories of memory and suggested that the point of view which appears to advantage at present is the one which interprets memory in terms of attitude and goal activity.

QUESTIONS FOR DISCUSSION

1. May one argue from experimental results obtained with nonsense syllables to any sort of remembering or forgetting? Why, or why not?
2. Explain the method of distributed learning and show how it would apply to your present studies.
3. What is the pedagogical problem respecting retention of verbal as compared with retention of motor skills?
4. What is your experience with irradiation? How does irradiation relate to the plateau? Suggest ways of preventing irradiation.
5. How would you decide when to use the whole method and when to use the part method of learning? Illustrate.
6. What benefits accrue from recitation as contrasted with "passive" learning?
7. Illustrate from your own experience the phenomenon of retroactive inhibition.
8. Discuss the relative effects of tangible and intangible goals, and of immediate and remote goals. How may the intangible and the remote goals become *real*, that is, operative, goals for a given learner?
9. Show the relationship of goal to feeling-tone.
10. How would you account for the transfer of motor skills?
11. How does the notion of "faculties" relate to the concept of "formal discipline"?
12. Should any curricular subject be valued primarily for its alleged disciplinary effects? Why, or why not?
13. Mention some implications of Thorndike's study on transfer values.

14. What inferences would you draw from the experiments of transfer?

15. Show that in order to remember, one must forget.

16. What problems are involved in ascertaining the nature of memory? Suggest possible ways of meeting these problems.

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CHAPTER V

INTELLIGENCE: WHAT IT IS AND HOW TO MEASURE IT

THROUGHOUT the discussion of learning, reference has been made, directly and indirectly, to *intelligence* as that expression of behavior which is exhibited by the individual, animal or human, in achieving the solution of a problem of adjustment. Whether this adjustment be the escape of an animal from an unfamiliar enclosure, the securing of food in a problematic situation, or the working-out a cross-word puzzle by a man, the behavior is deemed intelligent whenever it indicates selective utilization by the animal or the man of experience in meeting the new situation. This selective utilization, as we have frequently noted, involves the discovery of relationships, the discrimination of details relevant to one's purpose or goal, and the "sense" to profit by this discovery and discrimination in attaining the goal.

Intelligence, in the usage of contemporary psychology, thus appears as a term *descriptive of behavior,* and not as some sort of psychic endowment peculiarly human. Accordingly, when the psychologist measures intelligence, he measures, not some impossible abstract essence but the *responses* which an individual makes to a series of tests under specified conditions of control. How the psychologist proceeds in measuring intelligence, and what the significant results of this measuring are, this chapter will undertake to portray.

KINDS OF PSYCHOLOGICAL MEASUREMENTS

In psychological investigations, two kinds of measurement are generally used. One is the type of scale made up of absolute units, such as inches, centimeters, grams, degrees, and so forth; the other is the type of scale made up of relative units, as instanced in statistical computations.

In the first type, the standard of measurement is the instrument appropriate to the particular situation. For example, if one wishes to know the present temperature of one's body, one finds it directly by inserting a thermometer in one's mouth, after a few moments removing it, and noting the degree at the height of the mercury column. In the second type, the standard of measurement is a group performance, representing a statistical sampling and averaging of a large number of individual performances of a given sort, and the classifying of these in terms of 'norms' or standards of performance. For example, if one wished to know the intelligence rating of a college freshman named John Doe, one would request a psychologist to give this freshman an intelligence test, and the psychologist would interpret the resulting score by referring to the norms established from the testing of a significantly large number of college freshmen. Thus would John Doe's intelligence be determined *relatively* to the classificatory group to which he belonged.

HOW INTELLIGENCE TESTS ARE CONSTRUCTED

The modern intelligence test is a product of the scientific attempt to achieve a method by which individual differences in intellectual capability may be reliably determined. Traditionally, two methods of estimating intelligence had been widely used—school examinations and physiognomical signs. As for the first, it is now fully recognized by competent authorities, on the basis

of a host of scientific studies, that a pupil's standing in sundry curricular subjects provides no necessarily valid criterion of his capability. From the viewpoint of the classroom many a child has been classified as dull or mentally deficient, whereas the child's real difficulty could have been traced to emotional instability, to some physical disturbance, or to sheer lack of interest through ineffective motivation. As for the second, we now have indisputable evidence, through numerous statistical investigations, that any attempt to estimate intelligence from a "high brow" or from "bright eyes" or from any other facial "sign" is fraught with excessive error (3, 21).

Of course, it should be frankly admitted that the intelligence test, even today, is by no means a perfect instrument. Nevertheless, its development upon a scientific basis, and its demonstrated practicality in counteracting the gross diagnostic errors of the two methods just mentioned, compel its recognition as a superior method of rating intellectual capability.

Binet's procedure.—It is to the genius of Alfred Binet that modern psychology and modern pedagogy are indebted for the origination of a workable method of testing intelligence. His method proved to be workable for the reason that he conceived intelligence not as a composite of artificially abstracted elements, such as sensory analysis purports to reveal, but as a function of the adjustment of an individual to the situations which life itself presents.

Previous investigators had indeed made progress in devising tests for measuring various specific functions—keenness of vision, acuity of hearing, efficiency of reflexes, span of attention, memory for words and digits—but these tests proved to be of negligible practicality for determining intellectual capability. One could not differentiate a moron from a genius on the basis of sensory tests or even of factual memory.

Binet, however, succeeded in differentiating degrees of intellectual capability by defining it in behavior terms. "Intelligence," he maintained, "manifests itself in the best possible adaptation of the individual to his environment." Again, "Comprehension, invention, direction, and criticism—intelligence is contained in these four words" (1). And these four words denote precisely that selective discrimination which we have seen to characterize learning. With the possible exception of criticism, they apply upon both animal and human planes of activity, as evidenced in experiments. Whether or not it is legitimate to attribute to an animal the ability to criticize its own acts, in so far as its apparent recognition of a "false move" is concerned, is a moot question. Certainly, such an ability, if it exists at all, can have no *verbal* character. Indeed, the whole question of intelligence, as applied to animals, is one of definition, a definition that must take account of the principle of parsimony. But in terms at least of the evolutionary hypothesis, one may legitimately hold that organic behavior, from an amoeba to an Einstein, represents a linear series of increasing complexity.

On the human level, intelligence in the view of Binet is defined as a discriminative activity, the noting of likenesses and differences between things and between ideas, the ability to follow directions, to 'hold in mind' an objective and to coördinate activity thereto, to represent a situation in imagination, as in telling the time with the hands of the clock reversed, and to evaluate one's behavior upon an objective criterion of success. In short, *intelligence is the ability to analyze, synthesize, and generalize.*

From this definitive conception of intelligence Binet devised problematic situations deemed appropriate for children of different ages. He then noted the differences in achievement of the faster and the slower ones, and,

by addition and elimination of problems, determined what were suited to each age so as not to be too difficult or too easy. In 1905, after much experimentation, he brought forth his first scale for measuring the intelligence of children. This scale contained thirty tests, increasing in difficulty with advancing ages. Binet tried out this scale upon both normal and feeble-minded children, noting differences in adaptability on the part of the children of the same age, and noting also how many three-year-olds would pass, and how many would fail on the tests for that age; likewise with the four-year-olds, the five-year-olds, the six-year-olds, and so on.

After analyzing this 1905 scale for its deficiencies, Binet devised a new one, known as the 1908 scale. In this, he assigned a definite number of tests for each age from three years to thirteen years inclusive. In terms of this scale, a child was considered to be of normal or average intelligence if he passed at least sixty per cent of the tests for his age. As a rough criterion for checking the validity of the scale, Binet ascertained the judgments of teachers as to bright pupils and dull pupils, and discovered that the bright ones were superior in achievement on the tests and the dull ones inferior.

Here is the test for the six-year-old: (1) tells right and left by indicating right hand and left ear; (2) repeats sentence of sixteen syllables; (3) chooses the prettier in each of three pairs of faces; (4) defines familiar objects in terms of use; (5) carries out a threefold command; (6) gives age; (7) tells whether it is morning or afternoon.

In 1911 Binet published a more refined scale on the basis of extensive use of the 1908 scale in France, Belgium, Germany, England, and America. This last scale was extended to include year fifteen, and each test was assigned a definite age value. Hence the Binet type of test becomes identifiable as an *age scale*.

In the test for the six-year-old, cited above, one readily notes the sampling of daily life situations. The test is not concerned with schooling primarily, although schooling itself is a part of life situations. As Binet himself clearly recognized, the practical differentiation of the bright from the less bright is that the former not only gathers more information, both in school and out of school, but also makes more effective use of the information in his adjustment to varying situations than does the latter. And the value of the intelligence test as a diagnostic instrument consists precisely in its quick detection, through a sampling of common adjustments, of the bright and the dull, the potentially educable and the potentially uneducable.

Of course, it may be argued that a scale of this sort can never become universal in application because of the differing circumstances in which children are brought up, that differences in cultural status would nullify the results. In a measure this is true. It should be agreed that the scale presumes an environment that is approximately the same for the children tested; otherwise the scale could have no validity whatsoever. But all this simply means that any method of testing intelligence must take account of the general character of the environmental status of the subjects to be tested. A scale devised for the children of the United States would be inapplicable in many respects to the Eskimo children of Alaska, even though the language were the same. In fact, the Binet scale, constructed in terms of the environment of French children, has required modifying to meet the differing environments of the several countries in which it has been adopted, a circumstance of peculiar significance in directing attention to the fact that it is psychologically impossible to estimate intelligence apart from behavior.

The Stanford and other revisions.—The most widely known, and perhaps the most widely used, of American adaptations of the Binet scale is called the *Stanford Revision of the Binet-Simon*[1] *Intelligence Scale.* This revision represents the results of an extensive use of the 1908 scale, with necessary modifications for American children, by Professor L. M. Terman of Stanford University. Published in 1916, it contains a total of ninety items, fifty-four of which were taken from the Binet scale, and thirty-six of which are entirely new. Its age range extends from three years to eighteen (superior adult), and each test is assigned an age value in terms of months so that a simple calculation of tests passed gives the individual's intelligence rating as of so many months (or years) *mental age.*

The Kuhlmann revision (1912 and 1922) provides an alternative or supplementary scale to the Stanford, and extends the tests for the early years down to the age of three months. At the upper end, however, this scale does not go beyond age fifteen. Other revisions have been undertaken by Herring (1922), and by Yerkes, Bridges, and Hardwick (1915), both of which adopted a "point scale" rather than an "age scale"; that is to say, the test items, arranged in order of difficulty, are scored upon a basis of so many points gained for each test passed, the final score being translatable into mental-age equivalents according to the norms established for each age.[2]

The intelligence quotient (I.Q.).—In giving an intelligence test to a child, the regular procedure is to begin, not with the particular test corresponding to the child's own age, but with the test for two years earlier. The reason for this procedure, in the case of a child sus-

[1] Simon was Binet's collaborator.

[2] A brief description of these scales is a poor substitute for a study of the scales themselves. Every reader of the text should find opportunity for a first-hand perusal of those mentioned.

pected of dullness, is obvious. And in cases where the tests for the earlier ages are not passed in entirety, the rule is to go back still earlier until one reaches an age level where all tests are passed, then to proceed as far as an age level where no test is passed. The examiner then totals the score in terms of months, giving credit for all tests preceding the first one passed, and finds immediately the child's *mental age* (M.A.).

A child of ten, for example, may pass all tests through the twelfth year. Another child of the same age may not pass any test beyond those for the eighth year. The first child is thus advanced two years, the second child retarded two years, both relative to life age, or, as it is usually designated, *chronological age* (C.A.).

It should be remarked, however, that a two-year advancement (or retardation) at the chronological age of sixteen does not carry the same significance as it would at the age of six; for there is far less difference in range of intellect between sixteen and fourteen, say, than there is between six and four. Accordingly, one needs a formula to make clear the meaning of the relationship between the two ages (M.A. and C.A.). Such a formula was invented by Stern, a German psychologist, by the simple procedure of dividing the mental age by the chronological age and calling the result the *mental quotient* (26). So then, when the two ages correspond, the quotient is 1.00, and the individual who has this quotient is designated normal or average. In the examples cited above, the first child's quotient is M.A. 12/C.A. 10 = 1.20; the second child's quotient is M.A. 8/C.A. 10 = .80. The decimal point is usually dropped for the sake of convenience of expression, and the mental quotient is now called (after Terman) the *intelligence quotient,* or I.Q.

Thus the I.Q. appears as a highly convenient index of brightness. Since the child of average intelligence is

one whose mental age is equivalent to his chronological age—indicated as I.Q. 100—the ratio of the one age to the other becomes a clearly interpretative clue to potential intellectual development. Figure 10 shows the parallel growth of three levels of mental age relative to chronological age.

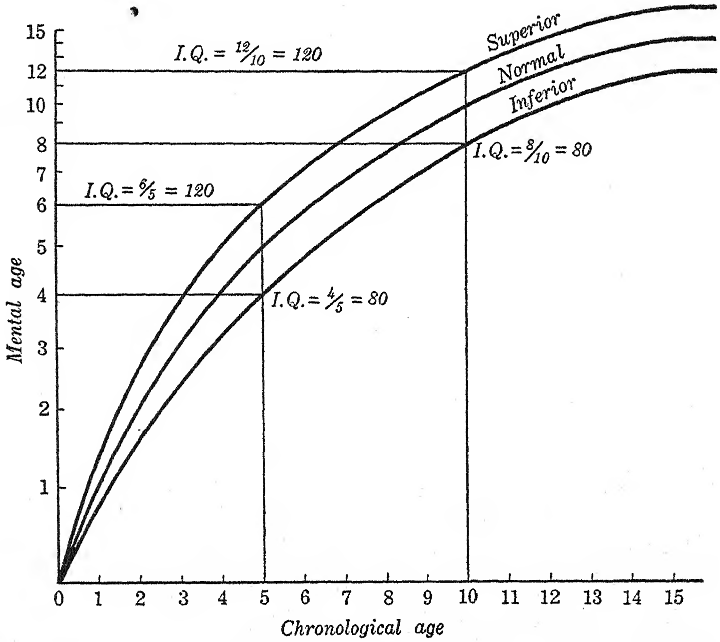


Fig. 10

Hypothetical growth curves which give a constant I.Q. (After Garrett and Schneck)

But one must not insist on classifying as normal only those whose I.Q.'s are precisely 100. To do so would be to ignore the patent fact of individual differences within any classification. I.Q.'s of 98 or 102 are not essentially different from each other or from an I.Q. of 100 as indices of intelligence. In fact, Terman found, by means of statistical analyses, that for each age group the variations within the middle fifty per cent were prac-

tically the same, that is, from fifteen to seventeen points. Consequently, it has become the policy in mental testing to allow a probable variation of twenty points, and to classify as of *average* intelligence all whose I.Q.'s fall between 90 and 110. Figure 11 shows how I.Q.'s are distributed in an unselected group of 905 children of C.A. 5-14 (28).

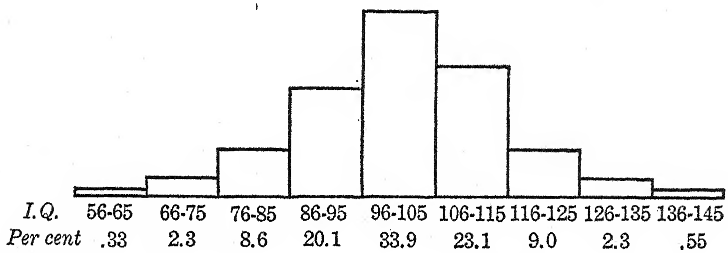


FIG. 11
[After Terman (28)]

For purposes of classification, the distribution of intelligence in the population at large may be represented as in Figure 12.

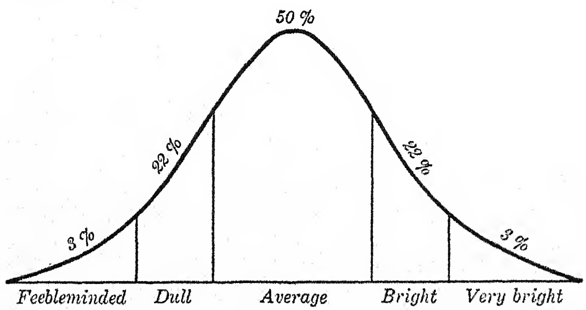


FIG. 12

Great care needs to be exercised in the interpretation of the results of a test. For example, Dunlap (4) has pointed out that if a child of eight passes the test for age five but fails on tests beyond this age, one is not entitled to infer that this child has the intelligence of a

five-year-old. One may conclude only that the child does not have the learning capacity of a normal eight-year-old. His capacity may be much lower than that of the normal five-year-old, for the I.Q. of the latter may be much higher than that of the eight-year-old. Certainly, the *intellectual capability* of a moron of a mental age of ten, is by no means equivalent to that of a normal child whose mental age happens to be the same.

Table I presents Kuhlmann's classification of intelligence levels for diagnostic purposes.

TABLE I.—[After Pintner (22)]

Grade terms	*Range in I.Q.*
Idiots	0– 24
Imbeciles	25– 49
Morons	50– 74
Border-line	75– 84
Dull	85– 94
Average	95–104
Bright	105–114
Very bright	115–124
Superior	125–149
Very superior	150–174
Precocious	175 and over

Group tests.—The Binet type of scale is intended for use primarily with individuals rather than with groups. Its method of scoring, therefore, is often thought to be more accurate so far as the actual I.Q. is concerned than is the case in group testing. The reason is that certain psychological conditions, such as emotional disturbance on the part of the child, may be more readily controlled by an examiner with a single child. Still, there is evidence to support the view that results of group testing are as reliable as those of individual testing (18). But individual testing is extremely time-consuming; the Stanford Revision requires from a half hour to one hour and

a half. Consequently, scales for group testing were not long in appearing.

One of the earliest and most extensively used of the group tests was the *Army Mental Test*. This was developed in 1917 by an expert group of psychologists under the authority of the surgeon-general of the United States army, and was administered during the period from October, 1917, to January, 1919, to more than 1,700,000 recruits. Two forms of this test were developed: *Alpha* for literates in the English language, *Beta* for illiterates

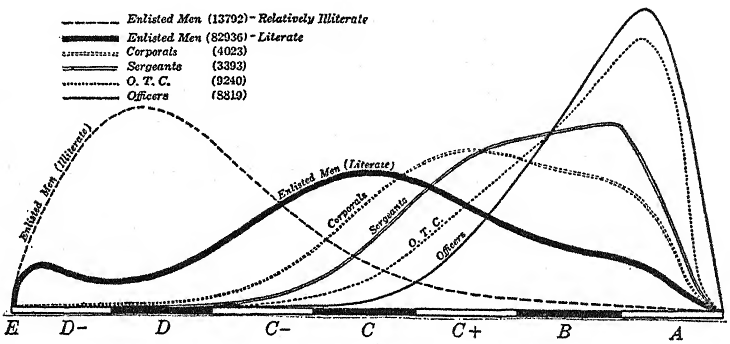


Fig. 13
Distribution of intelligence ratings in typical army groups

and those of foreign birth who were not familiar with English. Needless to say, the results of this wholesale testing have been of enormous psychological value, theoretically and practically (39). Figure 13 shows the trend of intelligence distribution for typical groups. Table II gives the percentages for each classificatory level of intelligence (40).

Other widely used group tests are the *National Intelligence Tests* (Grades 3-8), *Kuhlmann-Anderson Intelligence Tests* (Grades 1-12), *Otis Group Intelligence Scale* (Grades 5-12), *Thorndike Intelligence Examination* (High School Seniors and College Freshmen), the *American Council Psychological Examination* (High

TABLE II

Intelligence grade	Class	%	Score	
			Alpha	Beta
A	Very Superior	4– 5	135–212	100–118
B	Superior	8–10	105–134	90– 99
C+	High Average	15–18	75–104	80– 89
C	Average	25	45– 74	65– 79
C–	Low Average	20	25– 44	45– 64
D	Inferior	15	15– 24	20– 44
D–E	Very Inferior	7	0– 14	0– 19

School Seniors and College Freshmen), and the Terman Group Test of Mental Ability.

As a rule, tests devised for ages above the mid-teens do not express results in terms of M.A. or I.Q. The reasons for this will be considered in a later section. A common method of scoring group tests is to assign a numerical value to each item of the test, and to designate the total score of items passed as the *raw score.* But this score would be quite meaningless unless one knows what the norms of performance are for the particular test. At least, one would need to know the *average score* obtained from general use of the test.

Norms of performance may be expressed in a variety of ways—as *percentiles, deciles, quartiles, mean, median,* etc.—each of which is obtained by appropriate mathematical formulas. In the case of percentile rating the group tested is represented on the basis of 100, the percentiles thus ranging from 0 to 100. For example, Samuel Frosh obtains a raw score of 149. By consulting the norms for the particular test used, one discovers the percentile equivalent of 149 to be 80. This means that Samuel Frosh's position among college freshmen is such that 79 (or 80) per cent fall below him and only 20 (or 19) per cent rank above him. In other words, this position on the percentile scale definitely tells us that Sam-

uel Frosh is of superior intelligence as college freshmen go. In the case of deciles and quartiles, the rating is obviously much rougher—rankings in tenths and fourths —but nonetheless quite meaningful.

Moreover, on the basis of experience in determining fitness for college work, or for other purposes, one may assign a minimum score or rating called the *critical score*, the significance of which is that all who fall below this score are eliminated as most likely to fail. Numerous colleges, for example, do not admit candidates for entrance who fall below a specified critical score on an intelligence test or who place, in terms of high-school average, in the lowest quartile of their class.

VERBAL VERSUS NON-VERBAL AND PERFORMANCE TESTS

From the inception of the Binet scale, tests of so-called "general intelligence" have laid the major emphasis upon facility with verbal, abstract, or symbolic materials. Binet himself was led to this conception of intelligence through the practical necessity for furnishing a means of classifying pupils of the Parisian schools in the interests of instructional efficiency. And because of this practical necessity the tests have tended to a large degree to embody materials similar to those of school training. However, this tendency does not militate against the tests. For, as noted in a previous section, there is no possible way of testing intelligence unaffected by training of some sort or other.

Doubtless the term "general intelligence," as applied to mental tests, is a misnomer, in view of the obvious fact that an individual's adjustments to life situations are not by any means all of a verbal or abstract nature. Yet the identification of the intelligent with the verbal appears to have become fixed in psychological and educational literature, despite all protestations. Besides, popular speech has had something to do with this identi-

fication. For such speech has always tended to interchange intelligent with intellectual in characterizing those individuals whose capabilities are expressed in the verbal and symbolic. And this tendency, moreover, has accentuated an artificial distinction between knowing and doing, a distinction whose falsity is readily acknowledged as soon as one sees that either is meaningless without the other. One "does" symbolic tasks like arithmetic in no fundamentally different sense than one "does" the unraveling of a mechanical puzzle. And one "does" the one and the other on the basis of what one "knows." Any test, therefore, can reveal only what the testee has learned either through formal instruction or through informal contacts of daily life.

Thorndike and other psychologists have defined type of test in terms of specific functions to be tested. For example, *Intellect CAVD* indicates a test made up of items involving *completion of sentences, arithmetic, vocabulary,* and *directions. Intellect CAVDIO* indicates a test made up similar to the foregoing but with additional items involving *information* and *opposites. Intellect CAVDIOSR* signifies an addition of items involving ability to deal with *spatial relations* and ability in *reasoning* (31).

Thus it is possible to build up a test including items which call forth any number of specific abilities, verbal or non-verbal. What sort of items should be included, how many there should be, and over how wide a range they should extend are matters requiring expert judgment in methods of standardization. A test may include only non-verbal items, as of spatial forms, where the testee is required to complete geometric patterns, or to identify missing parts, or to detect similarities of design. Such tests arose out of the need for examining individuals with no adequate verbal facility, as in the case of the deaf, the mute, the illiterate, and the foreign-born.

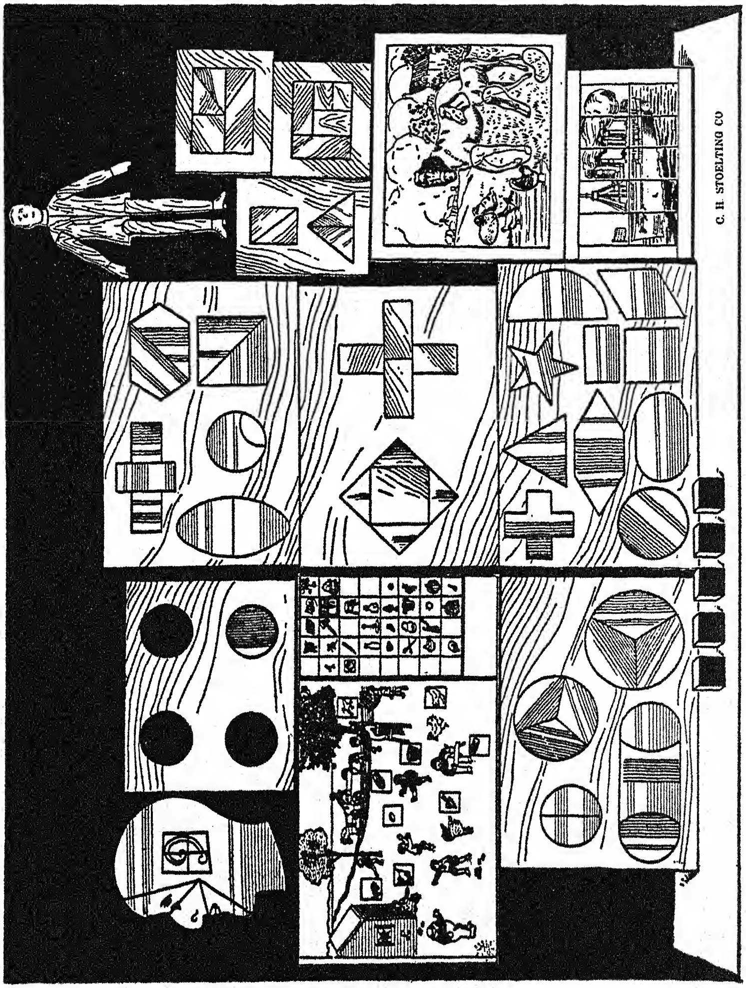


FIG. 14
The Pintner-Patterson Performance Test. (Courtesy of C. H. Stoelting Co.)

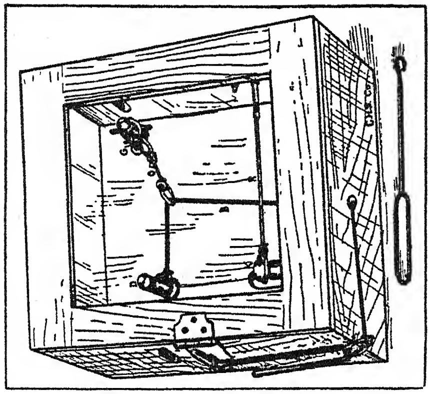


Fig. 16
Healy Puzzle Box

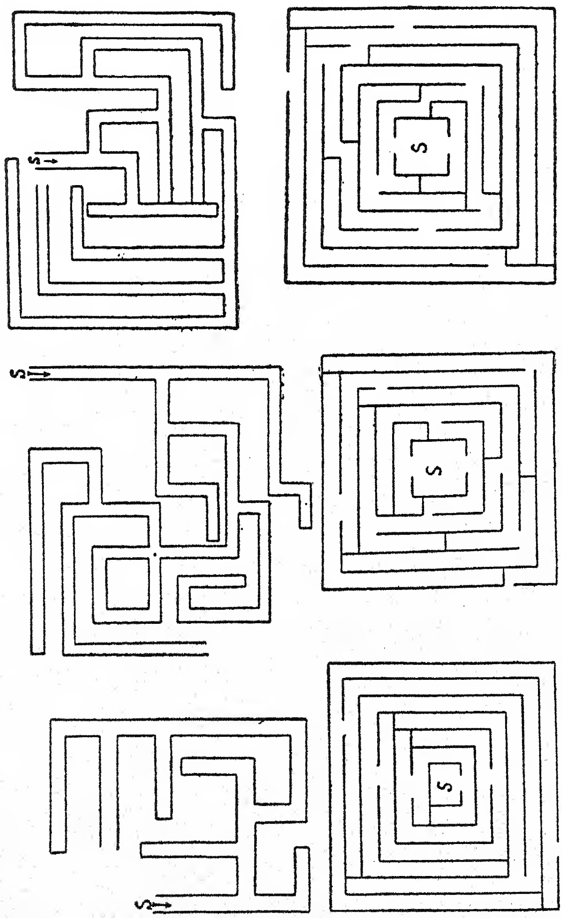


Fig. 15
Mazes

(Courtesy of C. H. Stoelting Co.)

Performance tests also involve no verbal or abstract features but differ from the foregoing type in requiring manipulation of objects. Examples, illustrated below, include *form boards,* in which the task is to replace in correct position certain segments cut out of the whole pictorial or geometric design. The jig-saw puzzle is a popular development of the form board, but it is not useful for psychological purposes unless standardized. *Puzzle boxes,* of which the Healy type is a sample, test manual ingenuity in solving the problem of opening. *Maze tests* call for perception of relations in following successfully through an intricate pattern of pathways to a final exit.

INTELLIGENCE IS FACILITY WITH TASKS

In brief review, we note that Binet's conception of intelligence as adaptation through comprehension, invention, direction, and criticism has furnished the mainspring for a prodigious amount of test construction. And we note also that his conception finds application in all types of tests, verbal, non-verbal, and performance. For practical purposes, *intelligence is simply a matter of facility with tasks. Intelligence tests comprise organized, standardized samplings of tasks for which there has been opportunity of acquaintance on the part of those tested and by which prediction as to capability of those tested may be determined.*

A scientifically dependable measure of intelligence concerns three essential factors: *level* or *difficulty, range,* and *speed.* And it is in terms of these factors that individual differences of intelligence stand out. Thorndike summarizes these factor-differences in three theorems:

> I. "Other things being equal, if intellect *A* can do correctly all the tasks that intellect *B* can do save one and in place of that one can do one that is harder than it, intellect *A* has the higher level."

II. "Other things being equal, if intellect *A* can do correctly all the tasks that intellect *B* can do, and can also do one more at the level of any of the others, intellect *A* has a greater range than intellect *B* has."

III. "Other things being equal, if intellect *A* can do at each level the same number of tasks as intellect *B*, but in a less time, intellect *A* is better" (32).

This last-mentioned factor, time, suggests the question as to whether or not *speed* is an important aspect of intelligence. Almost every intelligence test implies a positive answer to this question inasmuch as the tests include time limits, either for the test as a whole or for sections thereof. Yet one should note emphatically that the intelligence test does not make, it only reveals, the factor of speed.

Certainly, the workaday world tends to put a premium on speed by regarding it as a criterion of efficiency. But speed in itself has a double meaning; it may refer to *swiftness of execution* of a task or series of tasks, or it may refer to *rate of learning* a task. The distinction is important. One indeed would not consider the pianist who played a given composition in a shorter time than another pianist as necessarily the better performer, even though both played accurately. But one would designate as superior the pianist who could play accurately, at the age of twelve, say, compositions regarded as extremely difficult for performers of a much more mature age.

Speed, in the sense of rate of learning, is indicative of superior intelligence. This appears always to have been recognized in so far as school tests are concerned. For these ordinarily are constructed upon the assumption that, other things being equal—accuracy, for example—the learner who gets the most done in the time allotted is the better learner. And experimental studies support this assumption. One of these studies involved the testing of eighty-three students upon the learning of 1200

words of a German-English vocabulary. The learning period occupied three weeks. At the close of this period, the test revealed that one group of students, who had memorized 900 words, had an average retention of 76 per cent. Another group, who had memorized less than 300 words, had an average retention of only 46 per cent (20).

Another experiment involved the use of materials in the form of digits, nonsense syllables, words, prose selections, and poetry. The subjects of the experiment, 426 in number, included pupils from various schools and grade levels, college professors, inmates of institutions, and others.

Significant conclusions from this experiment were that those who learn quickly one sort of material tend also to learn other sorts quickly, and that those who learn quickly tend to use the "whole" method more often than do the slower learners. Moreover, retests of the same learners after intervals of three to ten weeks showed that the quicker learners had retained the most material, particularly the prose and poetry, the average score favoring the quicker learners by two to one (11, 33).

Speed, then, is a factor of intelligence. Invariably, in tests both of learning and of intelligence, the highest scores are made by the quickest performers. True, some of the experimental material, as cited above, is factual in character, demanding little more than rote memorization. But much of the material also demands insight into relationships, and hence is of value in testing intelligence. Indeed, a vocabulary test, which may appear at first sight to call for rote repetition, is psychologically regarded as the best single means of measuring intelligence (29).

GROWTH OR MATURATION

In the discussion of group tests, it was remarked that tests for ages beyond the mid-teens do not express results

in terms of M.A. or I.Q. This circumstance suggests the question as to whether or not one grows in intelligence at all beyond the mid-teens. This question, however, is but part of the larger question as to the probable growth of intelligence, so to speak, from a minimum to a maximum. At this point, therefore, the larger question may be considered.

All tests for determining mental age, whether of the age-scale or point-scale variety, are constructed upon the assumption that intelligence develops from year to year and that mental-age increments, as measured by levels of difficulty, parallel chronological-age increments. Presumptively, also, though the M.A. and the C.A. advance together, the I.Q. remains unchanged. But is it possible for an individual to have an I.Q. of zero? Should a child of three, who scored zero on an intelligence test, be rated as of zero intelligence? And why should tests fail, as they apparently do, to descry mental-age increments beyond the mid-teens?

These questions suggest the need for a clarification of three fundamental problems pertaining to the development of intelligence. These problems are: (A) When does intelligence begin? (B) Does it continue to grow up to the termination of the individual's life, or does it mature and then decline? (C) Is the I.Q. a consistent index of growth?

When does intelligence begin?—In dealing with the first question, one must bear in mind that the intelligence referred to is always that which is revealed through tests. Whether or not there is an intelligence existent but not amenable to measurement is a highly speculative question. Wherefore, to avoid speculative entanglements, psychologists often use the denotative term "test intelligence." Otherwise, the question captioning this paragraph is as impossible to answer as is the proverbial question pertaining to the beginning of any organic

growth—eggs, acorns, and the like. For intelligence is an aspect of learning, and no one can tell when learning *begins*.

The question above, then, can pertain only to the determination of the *zero point* in intelligence *as expressed through tests*. Obviously, if one proposes to *measure* intelligence, one must measure from some base that shall serve as a uniform point of origin. Moreover, the units of increment of the measure must be equal. Examples from physical measurements are familiar enough. One measures the height of a man from the point where the soles of the feet are in contact with the ground, representing zero inches or zero centimeters; and the units of increment are equal over the entire scale. And a man may measure his strength of grip by means of a *dynamometer*, calibrated in kilograms from 0 to 100. In both examples the point of origin is a constant zero, and the units of increment are equal.

But scales of intelligence have no real zero, and their units of increment are not equal in the sense that they represent actual or absolute units of intelligence. In intelligence measurement the zero point is an arbitrary one, as in the Stanford-Binet test which begins to measure at age three. And the point of departure for one scale is not always the same as for that of another scale. However, these shortcomings do not negate the practical usefulness of the scales. The problem indicated is one of achieving greater refinement of technique.

One line of attack upon this problem has been initiated by Thorndike (34). He suggests the practicability of arranging CAVD tasks according to degree of difficulty, and calibrating them in terms of a uniform scale of units of difficulty; for example, tasks which 999 out of 1000 adults can do, to tasks which only one out of 1000 adults can do.

But there is need for experimental determination of

difficulty degrees of tasks for organisms all the way up from the earthworm to man. Thorndike, himself, on the basis of extensive knowledge of animal learning, concludes that the sort of task which the earthworm can master is so near to zero in difficulty as closely to approximate the absolute zero of intelligence.

Since this experimental work has not yet been done, Thorndike has devised and utilized a somewhat rough method of determining zero intelligence by having forty psychologists, recognized experts in animal, infant, and feeble-minded psychology, independently rank in order of difficulty a list of fifty-six randomly arranged and randomly numbered tasks. This method he calls the *method of consensus.* By statistical formulas he discovered that the zero level of intelligence is approximately represented in such tasks as the following:

> "Having an object of sweet, pleasant taste in his mouth, will keep it there more often than spit it out.
>
> "Having an object of bitter, nasty taste in his mouth, will spit it out more often than hold it there.
>
> "Will not try to pull off his own fingers or toes.
>
> "Responds to his best and kindest friend, for example, mother or nurse, differently from his response to strangers" (35).

Another line of attack is indicated in the work of Thurstone (38). By means of statistical computations, far too complicated to report here, Thurstone discovered that with uniform conditions of selection of successive age groups for testing, there is a linear relationship between the absolute variability and the mean-test performance of these groups. When, therefore, the line of relationship is continued downward, it reaches a point slightly before birth. Figure 17 portrays this line of relationship.

The accuracy of his method, Thurstone states, is at-

tested by the congruence of the results with the ordinary expectation that intelligence begins about birth. "The fact that the mental growth curve passes through absolute zero at or before birth constitutes statistical evidence that test intelligence begins its development at this early

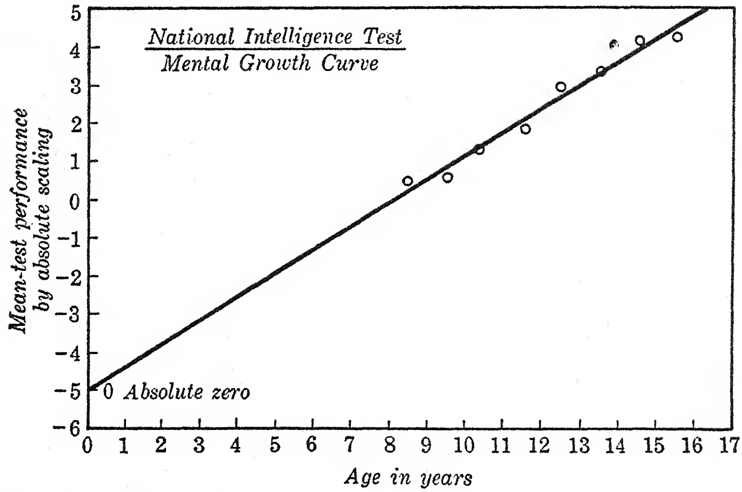


FIG. 17
(After Thurstone)

age even though it is not then directly accessible for measurement" (38).

Doubtless, in the near future, this problem of zero intelligence, in the sense of finding a uniform base line, and the correlative problem of determining equal scale units, will be solved through statistical ingenuity. Meanwhile, intelligence-testing will continue to serve the practical purpose of differentiating levels of capability which, though at present only roughly determined, are nevertheless an effective basis for instructional guidance.

Does intelligence continue to grow up to the termination of life, or does it mature and then decline?—From common-sense experience, this question would be answered negatively in respect to the first half, affirmatively

with respect to the second half. But as to the precise age when maturity is attained and decline begun, common sense would give answers varying all the way from twenty to sixty years of age. The above question is indeed a highly practical one in view of current efforts along lines of adult education, industrial efficiency, and social welfare. And the need, consequently, for a scientifically reliable answer becomes quite assertive.

Now measurements in terms of mental age, as we have noted, do not apply to ages beyond the mid-teens. The reason for this arose from the discovery by Terman and others that the Binet type of test ceases to differentiate individuals in respect to mental age somewhere between fourteen and eighteen. And, as a result of this discovery, some psychologists concluded that growth in intelligence reached its maximum at this period of life. Terman himself, on the basis of extensive data, determined upon sixteen as the most probable limit of mental age (30).

However, one should not be misled into concluding that an individual at this age ceases to learn. Not at all. Even if we grant the validity of Terman's conclusion, the observation should be clear that limit of growth is not synonymous with limit of learning in the sense that the latter represents the end of the road. One continues to learn *but on the level of the mental age one has attained at age sixteen.*

If, now, a boy of sixteen is found to have a mental age of twelve, we can be quite sure that he will be unable *to master* such high-school subjects as algebra, physics, and possibly languages, though he may be able to *acquire* a vast assortment of historical dates (16). Furthermore, if maximum development does occur at age sixteen, it would follow that an individual of equivalent mental age is *capable, intellectually,* of mastering any curricular

subject for which he has interest and the necessary prerequisites.

Yet, according to many psychologists, the location of maximum growth at sixteen, or earlier, is not a true location but is determined rather by the character of the Binet tests. Conceivably, tests could be devised which would demonstrate mental growth beyond sixteen or even eighteen. Thorndike has constructed CAVD tests which do measure differences for ages a few years beyond the Binet type of scale. Figure 18 shows the curve of mental growth as derived from Thorndike's investigations.

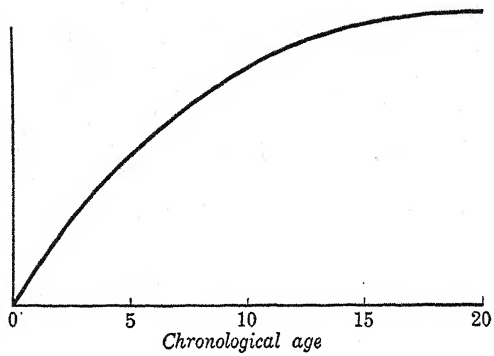


Fig. 18
(After Thorndike)

So far as test intelligence is concerned, then, growth appears to attain its peak at or about the end of the second decade of life. At this period, and later, the intellectual capability of any individual (excluding subnormals) cannot be determined on the basis of mental age but only on that of relative position in a group, as illustrated in percentile ranking. But whatever the basis of ranking, the point should not be overlooked that the ranking itself is a function of tests the predominant contents of which are of verbal, arithmetical, and other abstract material. Such tests, indeed, are doubtful of

application when administered to individuals beyond the "school age," whose interests have taken them farther and farther away from concern with abstract materials (36).

Beyond the age of twenty, data from intelligence testing are too meager for any final conclusion as to maturity and decline. No studies have as yet been made of growth and decline throughout the life span of individuals. And until many such studies have been made, conclusions will be based upon either common-sense observations or upon the few investigations already made upon groups at different age levels. One of these investigations, made upon the inhabitants of two American cities, indicates a tendency for intelligence scores to decrease with age (13). Table III presents summary data.

TABLE III.—Relationship of Intelligence Quotients to Age and Schooling [After Miles, from Goodenough (10)]

Age group	Eighth grade or less	1-4 years high school	1 year college or more
20–29	101	107	118
30–39	94	106	116
40–49	93	105	117
50–59	89	100	111
60–69	85	95	106
70–79	82	95	100
80–89	75	85	91
90–99	—	79	—

Concerning the above data it should be remarked that numerous individuals of the older age groups equaled or were superior in achievement to the general adult average. In general there is a definite decline with advancing age. A striking feature, however, is observed in the correspondence between degree of education and level of brightness; individuals below the college level drop below normal by the eighth decade of life. Apparently,

the proverbial "second childhood" is a function of mental level rather than of life age.

Is the I.Q. a consistent index of growth?—In answer to this question one may cite considerable experimental evidence; for, from the beginning of intelligence testing, the problem of the stability of the I.Q. has occupied a prominent place in psychological research. If, indeed, it should happen that on retesting children on various occasions the individual I.Q.'s varied over a wide range of points, then no confidence could be placed in such a fluctuating index of intelligence.

Here the problem has to do with the *reliability* of the tests, on the one hand, and of their *validity,* on the other hand. To be *reliable,* a test of intelligence must give consistent results whenever used for retesting the same individuals. To be *valid,* a test must measure what it purports to measure and not something else. How, then, may one know if a test is reliable or not, and valid or not? Upon these matters, psychologists employ the statistical device of *correlation,* a brief description of which may appropriately be given at this point.

We may consider, first, the question of validity. Already we have noted how Binet sought to validate his scale by ascertaining how results of testing compared with teachers' estimates of pupil intelligence. In general, Binet found that those children designated bright or dull by their teachers actually proved by the tests to be superior and inferior respectively. Here, then, in teachers' estimates is one criterion of validity. These estimates may take the form of personal judgments or the familiar academic grades. How valid these estimates are, in turn, need not here be considered. Suffice it to say that the more objective, in terms of performance, the ratings of pupils are, the more valid the criteria for determining the validity of intelligence scales. The whole

matter of testing is really one that calls for an ever-increasing refinement of procedure.

By correlating, say, the grades obtained upon scholastic subjects with the scores obtained on an intelligence test, one may establish the degree of relationship between the grades and scores. To illustrate: Figure 19 shows this relationship for a typical case by means of cross-lines.

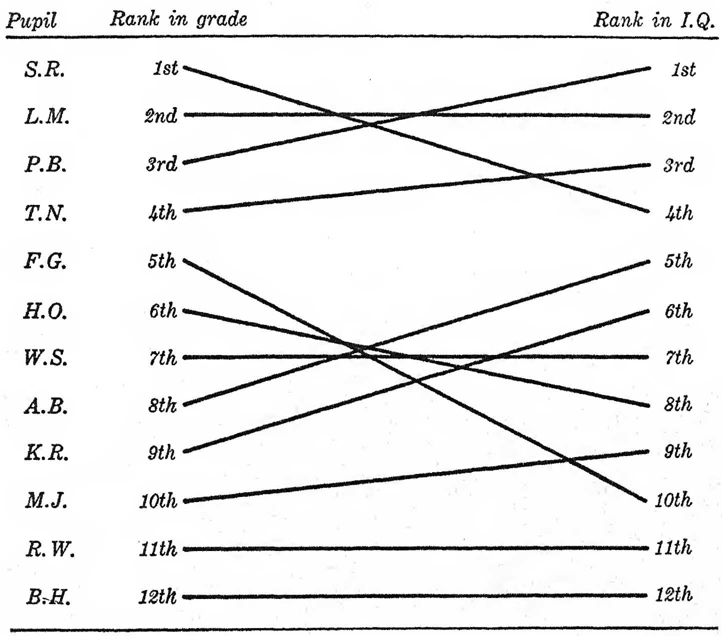


Fig. 19

From this figure, it will be seen that the rankings do not in every case coincide. They never do when traits are involved. Variability is the rule. Nevertheless, the diagram reveals tendencies toward groupings: the pupils superior in grades *tend* to be superior in intelligence; the pupils inferior in grades *tend* to be inferior in intelligence; likewise, the average or middle pupils.

These tendencies may be conveniently expressed in a *coefficient of correlation.* There are several methods of obtaining this coefficient, of which the one below is the simplest and will serve the purpose of illustration. It is known as the *rank-difference method of computing the coefficient of correlation.*

The formula employed is expressed thus:

$$\rho = 1 - \frac{6 \Sigma D^2}{N (N^2 - 1)}$$

in which ρ (rho) is the symbol of the coefficient, Σ means "sum of," D means "differences," and N means "number of cases."

Of the group represented in the diagram above, the average grades respectively are as follows: 98, 95, 90, 86, 84, 80, 78, 77, 75, 68, 60, 50; the I.Q.'s respectively are 110, 116, 120, 114, 96, 100, 101, 105, 102, 98, 85, 80.

To find the coefficient, one must arrange one of the series in order, beginning with the highest grade, for example, and designating each grade in rank order down to the lowest, as in the following illustration. The corresponding I.Q.'s should then be listed with appropriate rankings. Next, the differences between the two rankings should be taken, and in the last column the squares of these differences should be indicated. The numbers in this final column should now be added and the total multiplied by six.

In the group are twelve pupils ($N = 12$). According to the formula, this number should be squared and the result subtracted by 1. The next step is to take this subtractive result and multiply it by N, or 12. The numerator of the whole fraction should then be divided by the denominator and the result subtracted from the whole number 1. The final figure is the coefficient.

The procedure is illustrated below.

TABLE IV.

Average grade	Rank 1	I.Q.	Rank 2	D	D^2
98	1	110	4	3	9
95	2	116	2	0	0
90	3	120	1	2	4
86	4	114	3	1	1
84	5	96	10	5	25
80	6	100	8	2	4
78	7	101	7	0	0
77	8	105	5	3	9
75	9	102	6	3	9
68	10	98	9	1	1
60	11	85	11	0	0
55	12	80	12	0	0

$N = 12$ 62

$6\,\Sigma\,D^2 = 6 \times 62 = 372$

$N^2 = 144$

$N^2 - 1 = 144 - 1 = 143$

$12 \times 143 = 1716 \qquad 1 - \dfrac{372}{1716} = 1 - .216 = .784$

$\rho = .78$

The coefficient of correlation between grades and I.Q.'s for the above group is thus seen to be .78. But what does this mean? In simple terms, it means that for this particular group there is a rather high positive relationship between grades and intelligence on the part of these pupils; that is to say, high grades go with high intelligence, low grades with low intelligence, and average grades with average intelligence.

But the coefficient would have turned out negative had the grades and I.Q.'s distributed inversely. It would have turned out approximately zero, or actually zero, had they distributed inconsistently. Accordingly, coefficients may range from -1.00 through 0 to $+1.00$, as illustrated in Figure 20.

Coefficients of .80 and above, positive or negative, are considered "very high"; those from .30 to .50, "marked"; and those below .30, "low." In general, coefficients of zero, and near to zero, indicate no relationship other than that of chance between the functions concerned. Where

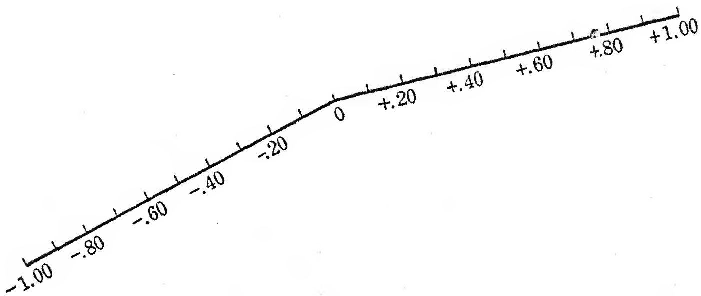


FIG. 20

the coefficient is negative the relationship is an inverse one; the higher values in one ranking are found with the low values in the other ranking. *But it is important to note that a coefficient of correlation never means percentage; it is purely a statistical device to express degree of relationship.*

When, therefore, one finds a high positive correlation between measures of intelligence and the measures of an accepted criterion, the former are said to be validated and thus serve as a basis, other things being equal, for *predicting* academic success.

However, a further question needs to be put, namely, how does one know that the particular group is sufficiently representative of pupils generally so as to furnish a safe basis for prediction? This question pertains to adequacy of *sampling*. One cannot legitimately infer, for example, that all Englishmen are "cold" and reserved if one has met but a few of them. Nor can one legitimately infer than an intelligence test is valid if standardized upon a relatively few persons. To be sta-

tistically valid, the coefficient of correlation must be derived from a truly representative sampling of cases.

The problem of adequate sampling need concern us only from the standpoint of *interpreting* coefficients of correlation. Whether or not the coefficient is reliably representative may be noted from its *probable error* (*PE*). This usually accompanies the coefficient with the symbol $\pm$ (plus or minus). To be reliable, the coefficient must be at least four times the value of its probable error. Thus, $\rho = .60 \pm .05$ means a high correlation, or fairly close relationship, between the functions tested, the reliability of which is attested by the fact that it is considerably more than four times its probable error.

All the foregoing considerations apply similarly to the question of *reliability* of intelligence tests. One may determine this reliability by correlating the scores on one half of an intelligence test with the scores on the other half, or the scores on odd-numbered items with scores on even-numbered items, thereby revealing the degree of internal consistency of the test. Again, one may correlate the scores obtained from testings and retestings of the same group of persons, and thus ascertain the test's consistency over a period of time. For, obviously, if the I.Q.'s obtained after an interval of twelve months, more or less, differ widely from the original testing, the reliability of the test may well be questioned.

As a matter of fact the cumulative evidence shows extraordinary consistency. Experimental studies of retests of several thousand children, over intervals varying in length from one hour to eight years, produce statistical proof of the reliability of the I.Q. as a diagnostic index of intellectual capability. This evidence, of course, is far too detailed to present in an introductory textbook; a very brief summary must suffice.

In Table V the coefficients of reliability between original I.Q.'s and retest I.Q.'s illustrate the fact of constancy.

TABLE V. [After Nemzek (19)]

Coefficient of correlation	Stanford-Binet	Group
.95–.99	5	1
.90–.94	15	3
.85–.89	20	9
.80–.84	23	6
.75–.79	12	3
.70–.74	9	4
.65–.69	8	0
.60–.64	3	1
.55–.59	1	0
.50–.54	1	0
	97	27

Median .83

Column 2 gives the number of experimental studies of Stanford-Binet results for each range of coefficients. Column 3 gives the number of studies of group-test results (19).

An examination of this table reveals the illuminating fact that over eighty-five per cent of the Stanford-Binet, and practically one hundred per cent of the group-test studies, give correlations of .70 and above. This fact, together with that of the median coefficient of .83, furnishes indubitable evidence of the constancy of the I.Q. When one considers the number of variable conditions under which tests and retests are administered to children, as well as the variability of attitudes, physiological conditions, and so forth, on the part of the children themselves, the extent of the correlations is remarkable.

It is found, of course, that fluctuating I.Q.'s occur from test to retest. In extreme and very rare cases the fluctuation may amount to twenty points or more. *On the average, however, the fluctuations do not exceed five to six points above or below the results of the original test.* Very large fluctuations may usually be accounted for on

the basis of wide variability in the conditions of the separate testings (24).

TYPES OF INTELLIGENCE

The kinds of tests thus far considered have been designed to measure three broad types of capability, namely, verbal, non-verbal, and performance. Verbal tests are concerned primarily with tasks of abstract, or intellectual, materials. Non-verbal tests may include tasks of an abstract character, as in the case of identifying geometric designs, or they may include tasks requiring the manipulation of objects or parts of objects, in which case they come under the category of performance tests. Between these kinds of tests there appear to be no sharp lines of demarcation respecting functions tested; on the contrary, there is more or less overlapping.

Nevertheless, from a wide use of these tests in a variety of life situations—scholastic, industrial, penological, and so on—a significant body of psychological opinion has developed to the effect that successful adaptation in one type of situation is no guarantee of success in one markedly different. For instance, it is conceivable that the possession by an individual of a high level of abstract intelligence may actually prove a handicap in certain life situations. Conversely, the possession of an I.Q. in the low nineties or high eighties may prove to be an asset to an individual, or at least not a liability, in adapting to situations that appear to require little, if any, abstract intelligence.

Such observations have led to the postulation of *types* of intelligence—*abstract, mechanical,* and *social.* By definition, abstract intelligence expresses itself in activities that are predominantly verbal and symbolic—such as vocabulary, mathematical representations, philosophical, scientific, and legal principles, laws, and formulas. Mechanical intelligence discloses itself as facility in the

use of tools and contrivances for purposes of construction and repair of objects in the physical world—buildings, engines, dams, telephone lines, and so on. Social intelligence appears in the art of handling people in all sorts of relationships, through persuasion, compromise, and practical knowledge of motivation (37).

But, again, these distinctions may be found to apply only to extreme cases, distinctions which may vanish altogether when applied to the majority of persons. Doubtless, from a surface view, one could cite numerous individuals who fit easily into one or other of the "types." A Kant might readily typify abstract intelligence, a Ford mechanical intelligence, and a Franklin Roosevelt social intelligence. But such classifications appear rather to reflect the cruder judgments of common sense than the judgments of scientific opinion.

In any case, the question of types can be answered only through experimentation. Fortunately, on some aspects of the question, a significant amount of experimental data is now available.

Experiments upon mechanical intelligence.—First of all, one may inquire if there is definite psychological proof of a distinction between intellectual capability and mechanical capability as above defined, at least to the degree sufficient to validate vocational counseling in the one direction or the other.

By way of preliminary consideration, it should be recalled that performance tests were developed as a means of testing children whose verbal equipment, for one reason or another, was palpably inadequate to allow them a fair chance on tests designed for general, that is, verbal, intelligence. From the use of these tests the conviction has arisen that a child who does poorly on a verbal test but very well on a performance test is not forthwith to be branded as "unintelligent." For, aside from psychological tests, it is well known from practical

experience that children who seem not to "make a go" of academic (abstract) subjects often excel in the manual arts. Hence it was highly opportune for psychologists to undertake to extend the use of performance tests in specification of mechanical ability.

Out of the profusion of experiments upon mechanical ability it will be necessary to select but a few of the more important ones for examination of typical results.

The *Stenquist* test consists of three series of disassembled objects—such as a common lock, mouse trap, bicycle bell—which the subjects are required to reassemble (25). The three series represent three levels of difficulty equated to three levels of school grade. The test has been adequately standardized, its reliability and validity coefficients exceeding .60. In correlating the results of this test with the scores on a composite group of six intelligence tests the coefficient was .21 ± .07 for a group of 275 seventh- and eighth-grade boys (25).

Analysis of the data reveals the following:

> Twenty per cent of the pupils are below average in general intelligence and above average in mechanical ability.
>
> Twenty-six per cent are above average in both general and mechanical intelligence.
>
> Twenty-three per cent are above average in general but below in mechanical intelligence.
>
> Thirty-one per cent are below average in both (25).

As Stenquist remarks, many of these pupils (twenty per cent), if judged wholly upon the results of a test of general intelligence, would have been erroneously regarded as having no ability, yet are discovered to excel in tasks requiring mechanical ingenuity (25).

The *Minnesota* investigation of mechanical ability offers the most extensive data yet available from a single project of this sort (5). This investigation was con-

ducted by a staff of psychologists of the University of Minnesota under the sponsorship of the *National Research Council.* It covered a period of four years.

After preliminary experimentation in constructing a battery of tests, a final group of tests was decided upon, part of which is illustrated in Figures 21 and 22.

The tests were applied to twenty groups of subjects, comprising pupils from elementary schools, high schools, a college of liberal arts, a college of engineering, vocational and technical schools, besides industrial employees. Results that are pertinent to our inquiry are as follows:

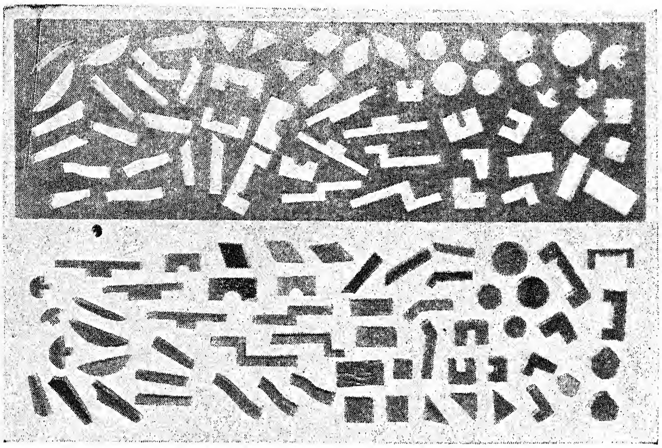
TABLE VI.—Coefficients of correlation between mechanical-ability scores and other factors

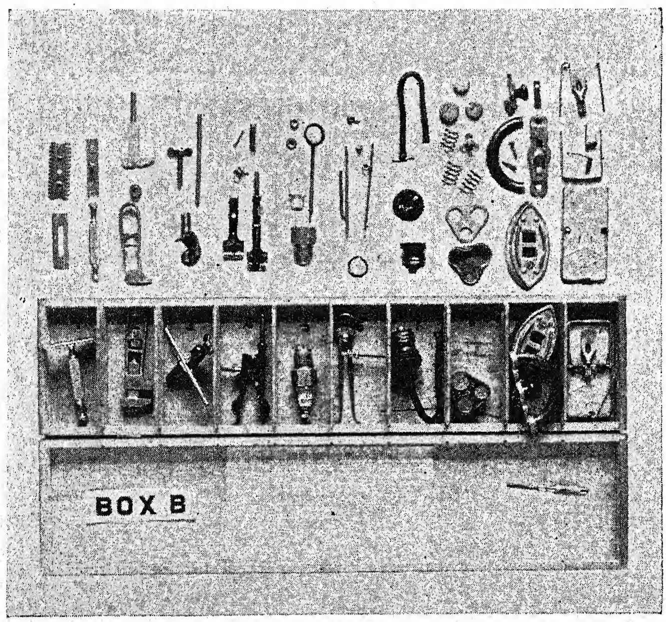
Mechanical-ability test scores and I.Q.,	.13
Mechanical-ability test scores and academic grades,	.24
Academic grades and I.Q.,	.57
Mechanical information scores and I.Q.,	.67
Paper form-board scores and I.Q.,	.53

From these results it should be noted that correlations between mechanical ability (as expressed in the manipulation of mechanisms) and relatively abstract ability are low, whereas those between tests involving comparable items of an abstract character are significantly high. Hence it would appear, as the investigators explicitly affirm, that mechanical ability is a unique function with respect to intelligence (6).

Upon the further question of reliable vocational counseling, the Minnesota experimenters discovered pertinent data showing that students in a college of engineering, as well as in technical and vocational schools, performed no better on the tests than did students of the liberal arts. From this, one may infer that many students select their programs of vocational preparation without dependable guidance in terms of their capabilities (7).

Experiments upon social intelligence.—Turning now to the question of social intelligence, one finds a com-





FIGS. 21 AND 22
This battery of tests, of very high validity and reliability, is probably the most useful device of its kind which has yet been achieved.
(Courtesy of the Marietta Apparatus Co.)

paratively great scarcity of tests for this type. The *Gilliland and Burke* test attempts to measure sociability in the form of ability to recognize facial expressions in photographs, and in the form of a questionnaire upon items of personal interest. Results indicate a very low correlation between scores on this test and intelligence scores (9). The *George Washington University Social Intelligence Test* employs photographs for purposes of determining ability to detect facial expressions and to identify names and faces, together with statements for testing knowledge of typical social situations (14, 15).

Such tests, however, appear to lack validity. Indeed, it is extremely doubtful if a "pencil and paper" test of social adaptability could be constructed so as actually to represent the situations in life where such adaptability is alone expressible. For it must be admitted that a person may know a great deal *about* effective social adaptations and yet be quite a failure *in* such adaptations. In fact, "pencil and paper" methods of testing, upon critical analysis, do not differentiate social (or mechanical) intelligence from so-called general intelligence. Correlations between intelligence scores and scores upon paper tests are found to be high, indicating that both types of scores are measures of the same thing, that is, intellectual capability (2, 12, 17, 23, 27).

SUMMARY OF THE CHAPTER

In review, one should note how Binet's definition of intelligence applies throughout the whole range and variety of tests. No matter what the variety of materials used—sentence completion, opposites, vocabulary, mazes, form boards, puzzles, arithmetic, or tool contrivances—the essential psychological processes of *comprehension, invention, direction,* and *criticism* find expression as intelligent behavior. To ascertain what this behavior is for purposes of scientific control and prediction, psychologists

take samples of the very stuff of daily experience and arrange them in the form of tests. To be sure, the tests are always susceptible of further refinement, as statistical controls well indicate. But all criticisms directed towards their apparent lack of refinement must take into consideration that by their competent application incalculable benefits have accrued to educational and social institutions. In this respect, the concepts of mental age and of I.Q. level are of epochal significance. No longer need the schools vainly attempt to "run the hare with the tortoise." No longer need the juvenile courts unwittingly seek to rehabilitate delinquents whose level of comprehension forever precludes their knowing "what it is all about." And no longer need vocational agencies continue the blind tactics of disregarding individual aptitudes, thereby misguiding credulous youth.

For the psychological tests have indicated a scientific basis for clear understanding as to how individuals differ from each other in *level of capability* and in *type of aptitude*. Of course, common experience has recognized the fact of differences all along. The hazard in using common experience, however, is that it often fails either to take into account these differences in a specific situation or to see their precise applicability for individual adjustment. Hence the trite and complacent observations that "brains will tell" and "you can't keep a good man down" are as likely as not to embody gross misconception. Common experience, therefore, needs the corrective information which comes only through application of scientific principles. And these principles the tests deliberately aim to embody.

No composite of tests, within one or the other defined "types," portrays a mutual exclusiveness of psychological functions. For no correlations are perfect. Type of intelligence, adaptability to different materials, are a matter of more or less. A philosopher *may* successfully

"fix" his car. A mechanic *may* enjoy reading Plato. A mathematician *may* become a successful organizer and leader of men. But psychologically and for practical guidance it is a far sounder procedure to emphasize not the exceptions to "types" but the consistency of intelligence patterns. Exceptions there are. Overlapping there is. Yet, notwithstanding exceptions and overlapping, psychological tests, through greater and greater refinement of construction and technique of application, are more and more disclosing the fact that individual intelligences *run in patterns* which, for some reason or other, "hang together."

Accordingly, the future of psychological experimentation lies along the line of constructing tests for measuring all sorts of *aptitudes*. Many such tests are already in use —tests of musical aptitude, of artistic talent, of salesmanship, of executive leadership, tests of aptitude for the professions of law, medicine, teaching, and scientific research, besides tests of more restricted abilities such as computation, prose appreciation, and logical discrimination (8).

QUESTIONS FOR DISCUSSION

1. Why did Binet's conception of intelligence prove fruitful for a program of testing? What does it mean to *measure* intelligence?
2. Describe Binet's procedure in devising and standardizing tests of intelligence.
3. Explain the derivation of the I.Q. What does the I.Q. signify?
4. What is the relative significance of a two-year advancement or retardation at ages fifteen and five?
5. Put the data of Table I in the form of a frequency distribution. What does the distribution show?
6. What is the meaning of a critical score? Illustrate.
7. What is the meaning of a percentile rating? Illustrate.
8. In what respects are verbal and performance tests alike and different as devices for measuring intelligence?
9. Discuss the factor of speed as an index of intelligence.
10. What is involved in a vocabulary test that should make it the best single test of intelligence?
11. Compare Thorndike's technique for determining zero intelligence with that of Thurstone.

12. What is meant by limit of growth of intelligence? How is this limit determined?

13. What is meant by validity, reliability, correlation, probable error?

14. How consistent is the I.Q. as an index of brightness? How is consistency determined?

15. Summarize the statistical evidence for types of intelligence. Of what practical importance is this evidence?

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CHAPTER VI

WHAT DETERMINES INTELLIGENCE

Thus far, the topic of intelligence has been treated descriptively. Now it will be expedient to consider it from an explanatory aspect in an attempt to answer the question, commonly asked: "What causes one individual to be more intelligent than another?" To answer this question at all adequately will require a survey of the accumulated scientific data upon such matters as *heredity and environment, mode of genesis, sex, racial origin, socio-economic status, physiological conditions,* and *age;* for these are the more pertinent conditioning factors of intelligence.

WHAT OF HEREDITY AND ENVIRONMENT?

Here indeed is a problem, pregnant with all sorts of issues, both practical and theoretical; a problem upon which an enormous amount of loose thinking has been exercised, with consequent misleading conclusions, not only on the part of popular writers but on the part also of scientifically trained individuals. In everyday usage the problem takes the form of an antithesis—heredity *versus* environment, thus implying a distinction which, upon careful analysis, may turn out as both erroneous and pernicious. At all events, to grasp the full import of this problem in its particular bearing upon intelligence, one must ascertain what are the *relevant facts* as disclosed through scientific investigation.

Are there innate capacities?—One may first of all take note of the origin of the antithesis above mentioned.

Why, in truth, should one speak at all in terms implicative of difference if not of opposition? The answer to this question is doubtless to be sought in the hoary belief that each individual comes into the world with so-called *innate capacities,* supposedly differentiable from behavior traits which he subsequently *acquires.* What precisely these "capacities" are has never been clearly defined. Even if one should identify them as "instincts," one has gained nothing by way of clarification; for no agreement has ever been attained upon the part of psychologists, sociologists, and educators as to what instincts actually are, and how many the individual is equipped with, if any at all. (See Chapter IX.)

Despite the fact that one cannot measure "capacities," but only performance, the belief in "innate capacities" has furnished an apparently inexhaustible fuel for a seemingly interminable controversy over the relative potency of heredity as *nature* and environment as *nurture.* Wherefore, as a practical educational issue, the controversy cries for settlement either through discovery that nature is the more potent or that nurture is, or that the problem itself needs to be redefined upon a more fruitful basis.

If heredity is discovered to be the dominant factor in individual development, then the educative program will perforce lay emphasis upon *differentiable* training; that is, training adapted to intelligence level without expectation of raising this level to any noticeable degree. A keynote of this emphasis would then be: *Once a moron, always a moron.* If, on the contrary, environment is discovered to exercise the dominant rôle, then the educative program will undoubtedly be framed to secure more and more favorable opportunities for raising a child's intelligence level through the invention of "jacking-up" methods (43). Here the keynote would be: *Environment makes the man.*

Still, such an alternative as expressed above, if rigidly insisted upon, would do violence to the logic of the problem by ignoring or excluding other possible solutions. To exemplify: Hereditary and environmental factors may balance each other as equivalent influences; or, environment may accelerate or retard or suppress the hereditary factors. In any case the problem can be settled, if at all, upon experimental evidence alone. To this evidence we may now turn.

What experiments in genetics reveal.—In strict scientific usage, *heredity denotes the transmission of characteristics from parents to offspring through constituent elements of the germ plasm.* The branch of science which studies the facts of this transmission, through microscopical and statistical observations of the effects of cross-breeding, is called *genetics.*

In popular speech, however, the term heredity does not carry the precise meaning above but rather expresses a confusion of meanings. One hears, for example, of the inheritance of democratic principles as though these were transmitted to offspring in the same sense that eye color is transmitted. And a recent reviewer, describing a certain author, states, "Two languages were his by inheritance. German he acquired later as a boy in school in Dresden" (53). Here is confusion propagated in high journalistic circles. Hence, for clarification of the problem at the very outset, one should be careful to differentiate *biological* heredity (germ plasm) from *social* heredity (moral codes, religious doctrines, political beliefs, and the like). Obviously, in a discussion of intelligence from the viewpoint of genetics, the only permissible meaning to be attached to the term is that of biological transmission.

As is well known, the science of genetics traces its source to the work of the Austrian monk Gregor Mendel (1822-1884), who, in experiments with garden peas, dis-

covered the operation of a *law of inheritance.* Mendel found, for example, that when he crossed yellow peas with green peas, the character of "greenness" failed to appear in the immediate offspring, but did appear in the next succeeding generation in the proportion of three yellow peas to one green pea. Many subsequent experiments along similar lines confirmed the stability of this three-to-one ratio, a ratio now always designated as the *Mendelian law of heredity.* In this ratio, the character appearing in the triple proportion is called *dominant,* the one appearing as single is called *recessive.*

Since the day of Mendel geneticists have carried on a multitude of investigations, on plants and on animals, and have accumulated therefrom a mass of information respecting the precise mechanisms of hereditary transmission. Much of this information is fairly recent and has been derived from experiments with the fruit fly (Drosophila) (27). This tiny organism can be observed under highly controlled conditions and through innumerable generations of offspring. Much information has also been obtained from experiments in the breeding of fowls, guinea pigs, and other animals.

A detailed description of the data obviously lies far beyond the scope of an introduction to psychology. Nevertheless, in view of the question of the inheritance of intelligence, a few essential facts should be presented. For instance, as a result of refined microscopic study, the actual cellular structures involved in inheritance have been isolated. These structures, called *chromosomes,* are strings of protoplasmic substance found in pairs, each pair carrying different sets of elements called *genes.* Although the genes themselves are invisible, they are assumed to lie like beads on the chromosome strings. In the reproduction of offspring, each parent contributes a set of chromosomes bearing the characteristics of the particular parental strain. These characteristics are re-

ferred to as *unit characters,* and appear to observation as eye color, complexion, tallness, length of fingers, and so on.

In the early development of genetic study it was assumed that each unit character had its origin in a specific gene. Recent investigations, however, have rendered this assumption untenable (18, 28). Red eye color alone, in the fruit fly for example, has been found to depend on at least fifty different genes. What this all implies, from the viewpoint of genetics, is that any so-called unit character represents the interaction of many genes. Some genes may intensify a given character; other genes dilute it; and others may prevent its appearance altogether.

Furthermore, the very potency of the genes in producing a given character depends upon *environmental* conditions. In botanical experiments the discovery has been made that some plants, whose genes produce a red color when grown in sunshine, will develop green if grown in shade. Again, fruit flies which carry a defective gene resulting in a maldeveloped abdomen will exhibit this condition if they are grown in a moist atmosphere, but not if they are grown in a dry atmosphere. "Whether the environment shall produce a given effect depends on the genes that are present at the beginning. Whether the presence of certain genes shall produce an effect depends on the environment in which the plant [or animal] lives" (19). In either case, it is impossible to tell *from the effects produced* whether the determining factor is hereditary or environmental (20).

How the experiments relate to the problem of intelligence.—What, now, is the significance of the above facts for our interpretation of intelligence? In the first place, it should be noted that all genetic experimentation has been carried on with certain of the more obvious physical characteristics and upon a limited range of living organ-

isms. This is quite natural and convenient. Eyes and skin and legs and hair are "there" to be seen. Changes induced by cross-breeding can be directly noted. And plants and the lower animals can be bred, under laboratory conditions, in great prolification. In the second place, the unit characters,[1] however obvious to perception, are not simple entities, as was once thought, but are highly complex affairs produced by a host of more or less interdependent genes. In the third place, the genes themselves are effective only under favorable environmental conditions. Hence the leading geneticists are agreed upon the conclusion that heredity and environment are not simple, mutually exclusive factors, but that each is interdependent with and indispensable to the other.

Intelligence not a unit character.—In view of these conclusions, one may readily see that intelligence can be no unit character, transmissible like eye color or hair texture from generation to generation. To assume, as many people do, that intelligence is an "innate capacity," and then to inquire as to the underlying genes for this "capacity," is to be concerned with a "will o' the wisp," and to become involved in meaningless phraseology. For intelligence, like horsepower and strength, can be understood and measured only as *performance.* One may indeed inquire as to an engine's capacity in terms of horsepower, but one does not think of the horsepower as somehow residing *in* the engine and as something *separable from* performance.

Yet, after all, the basis of intelligence must be structural in the sense that somehow brain cells are requisite. And for this basis, on the genetic hypothesis, there must be underlying genes. If, then, one insists on looking for the unit character for intelligence, one must look to the

[1] Jennings denies that there are unit characters and suggests the abandonment of the term (21). (Citation by Terman.)

brain or nervous system as the structural entity, just as one must look to the engine and its mechanical arrangement for the basis of horsepower.

But in all such inquiry, one should remember that neither intelligence nor the brain can be correctly envisaged as a composite of parts, each of which has its appropriate gene. Such a *mosaic* notion is, from the viewpoint of recent biological studies, utterly untenable. For, as Jennings remarks, "What each cell becomes depends, not alone upon what genes it contains, but on its relations to other cells. It can be proved that the same individual cell will produce many different things, depending on what its cellular environment is. Each cell contains all the genes, and these genes interact with the cytoplasm, so modifying it as to produce the later tissues and structures. But the genes alter their interactions, depending on the surroundings of the cells that contain them, producing different structures under different conditions" (22).

Intelligence not a matter of heredity "versus" environment.—The upshot of this whole account of the contribution of genetics to the problem of inheritance of intelligence is an insistent demand for a redefinition of the problem itself. This redefinition will preclude the concept of unit characters for the simple reason that it involves an abstraction, that is, the procedure of detaching a "piece" from its setting, and then assuming the piece to be an isolable entity. One may hold that this procedure of detaching is necessary in science for convenience of study. But the trouble is not the convenience of detaching; it is the overlooking of the aspect of convenience by a lapse into abstractionism.

Moreover, the redefinition will preclude any antithetical separation of heredity and environment for the now obvious reason that the problem is not one of "either or," nor is it one of "versus"; it is rather one of mutually

interacting conditions. Consequently, the psychological problem, under the influence of recent genetics, becomes reformulated as an inquiry into the relatively determinant rôles of these interacting conditions. But in pursuing this inquiry, it is manifestly impossible to adopt with human beings the genetic method of experimental cross-breeding. Psychology is perforce limited to the method of *statistical* investigation, whereby individuals are studied under varying conditions, and the effects of these conditions on performance measured.

CONDITIONING FACTORS OF INTELLIGENCE

If a person, uninitiated in the ways of science, should be asked how he accounted for his intelligence, he would doubtless reply that it was bequeathed him by his parents and ancestors. This way of explaining the origin of personal traits has been epitomized in the saying, "a chip of the old block." In what sense one is a "chip of the old block" so far as intelligence is concerned is a question for science to answer.

Single and multiple genesis.—From the biological side, one may consider a determinant of intelligence to be that of mode of genesis, that is, the conditions of germination and gestation. The problem here concerns, not the effect of parental strains (genes) upon offspring; for, as we have seen, it is not possible to control or to observe human cross-breeding through one generation after another; the problem rather concerns the way germination of offspring occurs, that is, whether as a single individual, as twins, triplets, quadruplets, or as quintuplets. Upon this problem there is all too little scientific information available respecting the last three modes of germination; what information is at hand is based upon studies of twins and siblings.

Siblings are ordinary brothers and sisters, generated as single individuals. Twins are of two kinds—identical

and fraternal. Identical twins are presumed to embody similar genetic constitutions, inasmuch as they exhibit similar features—hair color and texture, eye color, skin color, size and shape of fingers, and other characteristics. They are always of the same sex, both male or both female, and are so much alike in appearance as to be quite confusing to others. Fraternal twins may be of the same sex or of opposite sex, and may differ from each other just as siblings do.

Specifically, it should be reiterated, our problem is that of intelligence. Accordingly, whatever light may be focused upon this problem must originate from studies of test scores. These studies, fortunately, provide a significant body of data from which practicable conclusions may be drawn; for the data comprise comparative test scores of twins (identical and fraternal), siblings, and unrelated children, reared under conditions of environmental similarity and environmental dissimilarity.

The studies of identical twins provide the most crucial sort of evidence upon the relative effects of genetic constitution and environmental conditions. If one should grant the proposition that identity of constitution determines identity of intelligence, then differences of environment between the members of an identical pair of twins should not effect differences in their intelligence. For the sake of concreteness of presentation, four pairs of identical twins may be briefly described (32).

A and O (girls) were separated at the age of eighteen months and reunited at the age of eighteen years. About a year later, their I.Q.'s were taken: A, 84; O, 96. A had been reared in a large family in a crowded section of London, and had suffered from malnutrition and various diseases. O was reared in much better social circumstances in a small town in Canada. Both, however, received about the same amount of education—nine years—with additional training in secretarial work.

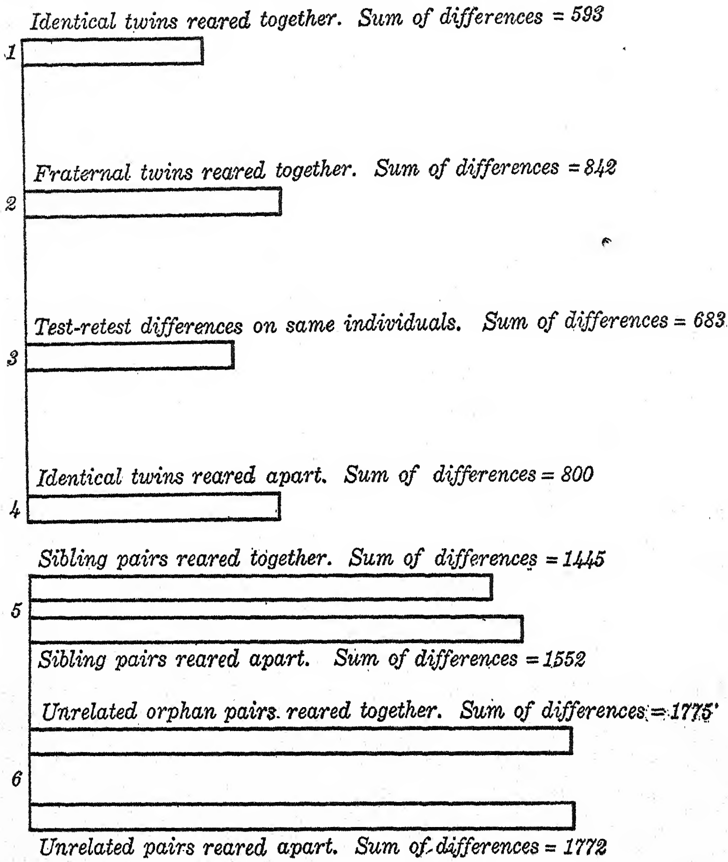
On the surface, the difference in I.Q. might be attributed to a difference in environment.

E and G (girls) were separated at eighteen months of age and reunited after an interval of twenty years. E (I.Q. 65) was adopted by an illiterate foster-mother and reared in a home of very low cultural status. In school, E did not go beyond the fifth grade and was frequently absent in order to help with housework. G (I.Q. 77) was placed in a convent at an early age and eventually graduated from a normal school. Both children are evidently of inferior intelligence, though G appears to advantage on account, presumably, of a better environment.

M and R (girls) separated at three months of age. At age sixteen their I.Q.'s were respectively 92 and 77. M was adopted into the home of a lawyer-bank-president and had the advantage of a high cultural atmosphere. R was adopted into a home of a laboring family and was allowed no social training at all. The difference in intelligence, in these cases, appears referable to a difference in training.

Richard and Ray were separated at one month of age and when examined at the age of thirteen had I.Q.'s respectively of 106 and 105. Both boys were in the eighth grade, but lived in homes of quite different cultural status; Richard having been adopted by an uneducated truck-farmer, Ray by a well-to-do physician. Since the I.Q.'s are practically equal, the environmental differences presumptively have had no particular influence in comparison with similarity of genetic origin.

These, and numerous other cases of identical twins, must be seen in comparison with fraternal twins, siblings, and unrelated children in order to obtain a conspectus of the full data. To obtain this conspectus without becoming involved in a mass of statistical details, the following diagrams and tables will serve as summary



FIGS. 23 AND 24

Aggregate of differences in I.Q. between paired members for various genetic groups. (After Schwesinger)

presentations of comparable data derived from many investigations (33).

TABLE VII. [After Schwesinger (34)]

50 pairs of identical twins reared together show average I.Q. differences of 5.3 points.

10 pairs of identical twins reared apart show average I.Q. differences of 7.7 points.

50 pairs of fraternal twins reared together show average I.Q. differences of 9.9 points.

The average differences in intelligence ratings on the part of identical twins are no greater than those in the case of retests of the same individual, namely, about six points. This means that an identical twin is as much like his mate as he is like himself. Curiously enough, however, some pairs of identical twins show differences in I.Q. as great as twenty points, as unrelated individuals do, although a very large number of identical pairs show no differences (34).

TABLE VIII.—Correlation Coefficients of Intelligence Among Different Genetic Groups. [After Schwesinger (34)]

Physically identical twins	.88–.90
Fraternal twins	.60–.70
Siblings reared together	.50
Unrelated individuals	.00

The above data show how the correlations diminish in size as genetic relationship varies; from which data the conclusion is inferred that intelligence is basically a matter of genetic make-up. Yet this conclusion is not an "open-and-shut" affair in the sense that one needs consider none but genetic factors. Here a number of apposite questions may be put.

In the first place, how may one differentiate environments as similar and dissimilar? In rather loose and rough terms one may describe *this* home as better than *that* home, or *this* school as better than *that* school; and one may even formulate a *scale of cultural values* whereby one home may be measured and weighed against another, and errors of estimates thereby reduced to a minimum. But one would still need to know how the cultural contents of a home—say, the presence of a piano or a shelf of books—related to intelligence score. Here is suggested a most difficult problem, and one upon which there is no clear light at present. In other words, the present ratings and comparisons of environments fail to assess the *intangible* factors—attitudes of parents

to each other, and of each to the children, for example—and these *may* have considerable influence upon intelligence (26).

In the second place, what, if any, is the tendency for individuals *to select their environment* on the basis of genetic constitution? Where the genetic basis is the same, as in identical twins, there should be a pronounced tendency to select or "take to" the same kinds of environment. Conversely, where the genetic basis is not the same, especially in the case of unrelated individuals, there should be widely varied selections of environment. Indeed, the claim is made that identical twins do create similar environments which, in turn, react to intensify the twin similarities; and that individuals of unlike genetic origin become more and more unlike by virtue of their selections of unlike environments. Plausible as this claim is, however, it has as yet no statistically substantial basis (35).

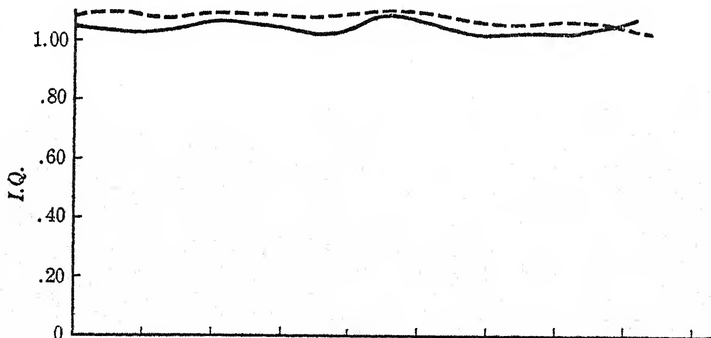
In the third place, does the evidence as to similarity of genetic constitution and intelligence *prove* this constitution to be the very matrix of intelligence? In reply, one may refer to the experimental conclusions, mentioned earlier, that genetic constitution is neither isolable nor explicable apart from environmental conditions. As Jennings puts the matter, the studies "prove both heredity and environment" and "agree thoroughly with the conclusion, practically certain on other grounds, that both the genetic constitution and the environment deeply influence mental and temperamental characteristics; and *that effects produced in one case by genetic constitution may be produced in another case by environment*" [2] (23).

What the practicable conclusions are, from all the evidence, may be considered in the next chapter. Meanwhile, it is of importance again to note how futile becomes the question as to which is more potent, heredity

[2] Italicized by the present writer.

or environment. Assuredly, the evidence leans neither in the one direction nor in the other, in the sense that one of them may be taken at the expense of the other.

Sex.—Regarding the question of sex as a condition of intelligence, there is a mass of indisputable data to the effect that in terms of so-called general intelligence the one sex is on a par with the other. Despite the popular opinion that males are intellectually superior to females—an opinion which is prone to cite the meager creations of women in comparison with those of men and which may have been responsible for the excessively retarded development of higher education for women as well as for the delayed enfranchisement of women—the psychological evidence respecting numerous intellectual functions actually reverses the opinion. Boys, indeed, tend



C.A.	5	6	7	8	9	10	11	12	13	14
Boys	1.00	.99	1.01	1.00	.98	1.03	.96	.97	.96	1.00
Girls	1.04	1.05	1.03	1.02	1.02	1.03	1.01	.99	.97	.96

FIG. 25

Broken line shows median I.Q. of 448 girls; solid line shows median I.Q. of 457 boys. (After Terman)

to excel girls in such capabilities as mathematical reasoning, spatial discrimination, manipulation of tools, and general information, but girls tend to excel boys in linguistic ability and in tasks requiring memorization. So far, this circumstance of sex difference lends a little sup-

port to the view that the male pattern of capabilities is noticeably variant from that of the female pattern, but the variability within a sex is far greater than is the variability between the sexes. There is, therefore, no psychological basis for any educational program that would give differential training on the basis of sex.

Figure 25 presents typical results obtained by use of the Stanford-Binet test (44).

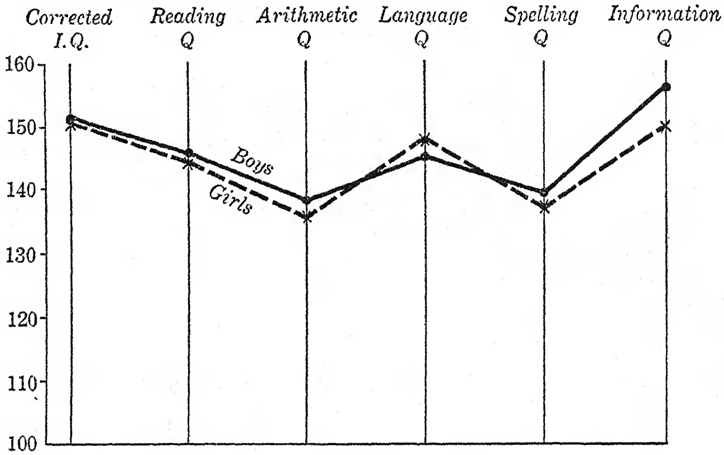


Fig. 26

Subject quotient profile of gifted children. [After Terman (45)]

Figure 26 shows the sex relationships of achievement for 307 boys and 258 girls (Terman's gifted group) of ages six to fourteen. Note also Table IX.

Table IX.—Army Alpha Scores for College Men and College Women [After Yoakum and Yerkes (58)]

Men (20 colleges, 3175 cases)		Women (13 colleges, 1575 cases)	
Highest 25%	154	Highest 25%	142
Median	130	Median	127
Lowest 25%	105	Lowest 25%	106
A and B grades....	75.4%	A and B grades...	75.8%

Many other studies, in addition to the above, present similar results on the problem of sex differences. Intelligence, as such, appears to admit of no sex lines. Whatever differences do appear between the sexes can be accounted for in terms of specialization of training, in school and in home, and under the regulation of social conventions.

Racial origin.—As in the question of sex differences, so in that of racial origin, a great deal of test information has been gathered. Here, however, the conclusions are rather of a tentative character inasmuch as many variable factors—language, cultural opportunity, and so forth—enter to qualify any conclusions which may be drawn.

From the army tests, for example, the native whites are far superior to northern negroes, and the northern negroes to the southern negroes (58). Average scores for these groups are presented in the table below.

TABLE X.—Army Test Scores for Whites and Negroes
[After Yoakum and Yerkes]

Alpha (literates) averages		Beta (illiterates) averages	
Native whites	59	Native whites	43
Northern negroes ..	39	Northern negroes ..	33
Southern negroes ..	12	Southern negroes ..	20

A study of the intelligence of school children in three southern states (1726 white, 1424 negro) shows the negroes to be consistently inferior at all ages and upon all tests, the average I.Q. of the white children being 88, that of the negroes 68 (12). Another study of intelligence scores of 222 negroes in a normal and industrial school gives a median I.Q. of 78, the comparable I.Q. for whites being 100 (7).

A comparative analysis of test results among negroes and whites indicates that negro inferiority is much

greater on verbal tests than on performance tests—a circumstance which provokes the comment that no valid conclusions as to negro inferiority can be drawn until there is equality of training for the negro, both as to kind and amount (7).

Performance tests have been administered to typical racial groups on the European continent. Ten groups, of 100 boys in each group, were chosen from Germany, Italy, and France, with an additional three groups of city children from Paris, Hamburg, and Rome. The results show no significant differences of intelligence between the racial groups, but do show the city children to be superior to the rural children (25).

A great amount of testing has been done with American Indians. In a group of 2650 full-blooded Indians attending government schools the average I.Q. was 69. Results of performance tests upon 667 full-blooded Indians in schools of the southwest gave an average I.Q. of 71. As with other racial types, there are wide individual differences. One Indian girl was found to have an I.Q. of 142 (13).

In the three states of California, Tennessee, and Louisiana, 2457 school children of diverse racial stocks were given intelligence tests. In practically every case, the children were American-born, and thus suffered no handicap of language difficulty. Typical averages are presented in the following table.

TABLE XI.—Average I.Q.'s of American-born Children of Different Racial Stocks [After Goodenough (16)]

Jewish	106	Portuguese	94
Chinese	104	Armenian	92
Scandinavian	103	Slav, Serb	92
American	101	Assyrian	92
Japanese	101	Italian	89
German	101	Spanish-Mexican	88
British	100	Hoopa Indians	85
French	94	Negro (California)	85
Swiss	94	Negro (South)	78

In interpreting the above scores as indices of intelligence, one should always bear in mind the fact that racial classification is more or less arbitrary. It has been said that there is but one race—the human race (14). Any view of race as a sort of permanent entity is bound to be mythical, for the evidence is incontrovertible that races are in constant flux and interaction. Whatever the claim for racial purity, and whatever the scheme of circumscribing a nationality, both are in the last analysis of political origin.

Practically all investigations of racial intelligence have taken the white average as the norm. Consequently, comparative scores must be understood in relation to the question of equivalence of cultural experience and training, especially from the verbal aspect of training. It has been noted that racial differences become much less marked when comparisons are made of scores on tests of a non-verbal character. Why this is so is not altogether clear. American-born children of foreign parentage often exceed the native white children both on verbal and on non-verbal tests. Certainly, as Terman has pointed out, there is no reason to suppose that the language handicap should operate in the case of Italians, Mexicans, and Spaniards but not in the case of Chinese, Japanese, and Scandinavians (46).

This whole problem of racial intelligence calls for much more experimentation, especially in connection with racial stocks for which cultural background and opportunity for training have been approximately equalized. Until this is done, all interpretation of racial differences must be qualified in no small degree (15).

Social and occupational status.—In this section we are to consider what the relationships are between intelligence level and those environmental conditions which characterize the home. That such relationships exist is a matter of common observation, despite the oft-

expressed resentment toward any suggestion of distinctions or levels within a democratic order. The commonplace remark, "I am as good as the next fellow," may reflect democracy in principle but not in fact. Our question, however, is not one of affirming or rejecting the democratic principle. We need only accept, for purposes of psychological study, the patent fact that social and occupational levels do exist and that people adjust themselves largely in terms of these levels; for, by and large, these levels, as Taussig remarks, "are based on the great fact of long-established social stratification" (39).

Concretely, our problem here reflects again the nature-nurture controversy, namely, as to whether or not we are utterly dependent upon our early environmental conditions for level of intellectual growth, or whether or not one can, by virtue of native endowment, actually rise above environmental limitations. One readily calls to mind "the poor boy who makes good" and "the rich boy who amounts to nothing." Does native ability, then, seek its own level, or may this ability be thwarted and stifled by unfavorable circumstances? How may we know that Taussig is right when he says that many "are kept in the ranks because no way is available for bringing out the sterling qualities which they do possess"? How should we answer his question, "Can it not be inferred that the broad differences between social classes rest on differences in their inherent intellectual and moral endowments?" (40, 41).

These are questions of profound social, as well as psychological, import. One may take the somewhat fatalistic attitude that "No good thing can come out of Nazareth," or one may believe it possible to "snatch a brand from the burning" and thus provide opportunity for a "budding genius." But whatever the attitude, one should be ready to modify it in accord with scientific data rather

than cling to it as a preconceived opinion. What these data are, we may now consider.

First of all, the problem of determining levels of social and occupational status should be considered. Earlier in the chapter we noted the difficulty inherent in the rating of environments and of correlating specific environmental effects with differences in intelligence. However, numerous scales have been devised in an endeavor to classify environments upon the basis of occupational ranking, or of economic level, as indicated by the material equipment of a home. Typical are the *Barr Scale* (1), the *Sims Scale* (38), and the *Whittier Scale* (54).

A typical classification of social-occupational levels is presented by Taussig (42).

> *Professional—E.g.*, lawyers, physicians, higher-grade teachers, industrial managers, college professors, clergymen.
>
> *Clerical—E.g.*, bookkeepers, salesmen, grade teachers, foremen.
>
> *Skilled work—E.g.*, carpenters, plumbers, bricklayers.
>
> *Unskilled work—E.g.*, motormen, miners, factory workers who watch and apply machinery.
>
> *Day labor*—those "who have nothing to offer but their bodily strength."

Studies in several countries show consistently that intelligence level rises and falls with occupational level (57). The results of a recent British study, for example, may be seen in Figure 27.

Some of these occupations—telephone operators, carpenters, sheet-metal workers—have a much higher median I.Q. than is the case of the same occupations in America. It may be that the keen competition for desirable positions in England compels many persons to accept jobs for which their I.Q.'s are too high.

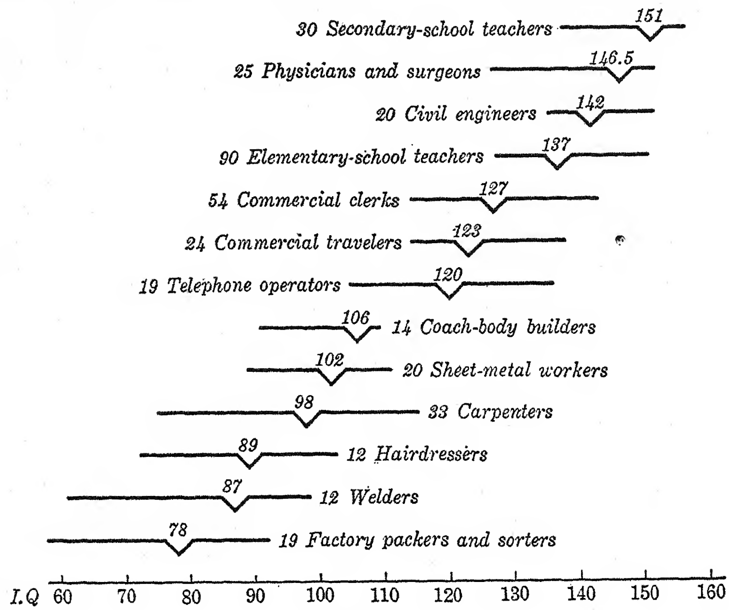


Fig. 27

Intelligence levels in various occupations. Each line represents the scatter of the middle fifty per cent in that occupation. The position of the median is indicated by a $\vee$ and a figure above it. [After Cattell (6)]

In America, the army-testing program produced results as indicated in Figure 28.

Many other studies upon groups of individuals, from pre-school children to adults, indicate unmistakable differences in terms of levels. Terman, from his extensive studies upon the incidence of genius in the population, is convinced that "individuals of the various social classes present these same differences of intelligence in early childhood, a fact which strongly suggests that the causal factor lies in original endowment rather than in environmental influences" (47). And the Minnesota study of mechanical ability offers the conclusion, based upon correlations between measures of ability and measures of environment, that "conditions that might be con-

sidered advantageous for developing mechanical ability do not in themselves have any perceptible effect on the boy's mechanical ability . . . that mechanical features of the environment are no more likely than cultural conditions to be positively correlated with any of the measures of mechanical ability" (10).

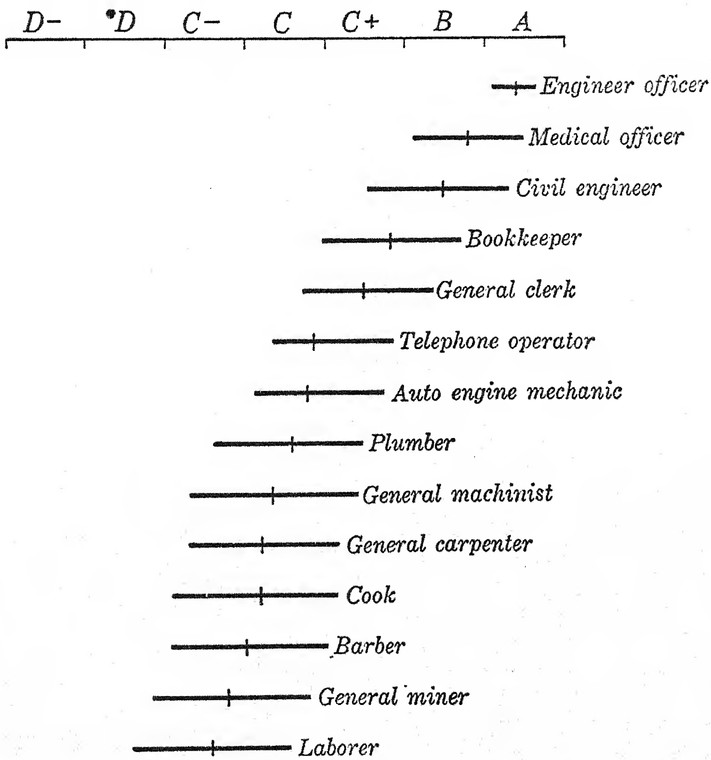


FIG. 28

Relation of occupation to intelligence in the army. [After Yoakum and Yerkes (59)]

On the other hand, it is well to note exceptions. Kawin's study of tests of nursery-school children (one group from a slum area, and one from a wealthy suburb) shows that while the majority of the highest ten per cent are children from the professional families, and the majority

of the lowest ten per cent are from the families of the labor group, yet some of the highest scores are made by children of the labor group, and some of the lowest scores by children of the professional group. The majority differences, moreover, appear chiefly in scores on verbal tests, as in the Stanford-Binet test. When performance tests are used no significant differences appear (24).

Perhaps the most crucial investigations upon the effects of cultural status are those pertaining to the study of foster-children who have been subjected to change of environment by the procedure of adoption. Two important investigations may be cited—one by Freeman (11), and one by Burks (4).

Freeman's study concerned 401 children, sixty per cent of whom were from Chicago and suburbs, the remainder from other cities of Illinois. Ratings of the foster-homes comprised data upon the material environment, evidences of culture, occupation, education, and social interests of foster-father and foster-mother. Seventy-four children, who had been tested by the Stanford-Binet scale prior to their transfer to foster-homes, were retested after having spent four years in the foster-homes. The average age of the children on the first test was eight, on the retest, twelve. The results were as follows:

Original I.Q. and home rating.... $r = .34$
Retest I.Q. and home rating...... $r = .52$

Dividing the homes into two groups—better and poorer —the results showed that the children of the better homes had an average I.Q. increase of 5.3 points (95.2-100.5); those of the poorer homes had an increase of but .1 point (88.0-88.1). Freeman, accordingly, regards these results as evidence of environmental effect upon intelligence.

Freeman also studied the results of placing children from the same family into contrasting foster-homes. For

purposes of comparison he chose 130 pairs of siblings whose average age at placement was a little over five years—one-third of whom were less than two years of age. Representative results are as follows:

I.Q.'s of siblings separated less than seven years	$r = .41 \pm .07$
I.Q.'s of siblings separated more than seven years	$r = .27 \pm .08$
I.Q.'s of siblings separated before age of six	$r = .25 \pm .09$
I.Q.'s of siblings separated after age of five	$r = .43 \pm .09$

From these figures it is concluded, first, that length of separation and consequent disparate environmental effects lower the correlations; second, that the earlier the age of separation, the greater the differences in intelligence upon the part of members of a sibling pair. These results are significant in view of the fact that the coefficient of fraternal resemblance in intelligence is .50.

A further conclusion is that those siblings who were raised in widely contrasting homes show greater differences of I.Q. than those raised in similar homes. Tables XII, XIII, XIV portray typical data.

TABLE XII.—Average I.Q.'s of Foster-Parents and Children [After Freeman]

Parents	I.Q.		Cases
	Parents	Children	
Fathers:			
Superior	122	104.9	68
Average	102	97.0	61
Inferior	87	93.8	51
Mothers:			
Superior	115	104.9	64
Average	100	97.8	91
Inferior	83	94.3	100

TABLE XIII.—Relation of Home to I.Q. of Foster-Children [After Freeman]

Type of home	Average I.Q.	Cases
Good	106.8	114
Average	96.4	186
Poor	88.9	101

TABLE XIV.—Relation of Occupation of Foster-Father to I.Q. of Children [After Freeman]

Occupation	Average I.Q. of children	Cases
Professional	106.8	61
Semi-professional and business	101.1	160
Skilled labor	91.6	149
Semi-skilled labor	84.9	19

From these tables one can readily see that there is a direct relationship of environmental status to intelligence level of foster-children. Freeman presents further data relating to the mentality of the children's own parents. These data may be summarized as follows:

> Twenty-six per cent of own fathers were subnormal.
> Fifty-one per cent of own mothers were subnormal.
> Of 120 children who had one parent subnormal the average I.Q. was 92.9.
> Of these children, only 4% had I.Q.'s below 70.
> Of 26 children who had both parents subnormal the average I.Q. was 81.2. Those of this group who were removed before the age of five had an average I.Q. of 86; those remaining with their own parents beyond the age of five had an average I.Q. of 78.1.
> Of 13 subnormal mothers whose average I.Q. was 68.1, their children (20) had an average I.Q. of 94.9.

In view of such data as Freeman has produced from his large and painstaking investigation, it seems hardly permissible to conclude that feeble-mindedness is trans-

mitted as a unit character or that environment has negligible influence upon development.

From a study of California foster-children, Burks is inclined to the view that environment is not nearly so important as a condition of intelligence as Freeman claims it is. In this study the children were selected on the basis of identity of race and similarity of educational opportunity. Adopting methods comparable to Freeman's, Burks obtained results which may be briefly summarized (5).

Good homes may increase, and poor homes may decrease, the I.Q. by as much as twenty points. Such instances, however, are quite extreme, occurring but once or twice in a thousand cases. From elaborate statistical computations, Burks concludes that heredity counts for eighty per cent of intelligence. While agreeing that environment has some influence, its effect is to "permit" heredity to assert itself, more especially in the cases of better homes. By way of disagreement with Burks, Freeman affirms that environment is just as potent an influence as is heredity.

It may, of course, be suggested that the superior foster-parents tend to select the brighter children. However, both Burks and Freeman deny that such selection occurs to any noticeable degree. Of Freeman's cases, sixty per cent were adopted younger than four years of age, an age when little information could be had on the matter of intelligence. In fact, eighty per cent had not even been tested prior to adoption. Of Burks' cases, investigation showed that foster-parents seldom consider intelligence in selecting for adoption; these parents place practically the entire emphasis upon sex, age, and complexion. Out of 166 cases, only four parents specified intelligence.

So far, then, the questions posed at the beginning of this section may be answered precisely as the question as

to the primacy of heredity and environment was answered, namely, that effects produced in one case by heredity may in another case be accounted for by environment. Therefore, a good thing *can* come out of Nazareth. The poor boy *may* "make good"; and the rich boy, despite the utmost favorable environment, *may* fail miserably. The further problem, then, is to discover the "potentials" in whatever stratum of society we may choose to dig, and to provide for these the full opportunity of the democratic order. And here, it is psychology that points the way.

Physiological conditions.—Respecting the physiological conditions of intelligence, the field of research is both very wide and very complex. In the present section, a few of the more directly pertinent conditions will be considered as they relate (1) to the brain and nervous system, (2) to the glandular mechanisms, and (3) to miscellaneous physical defects and illnesses.

The brain and nervous system.—Despite a vast amount of experimental research upon brain structure and function, comparatively little is known of the specific relation of the brain to intelligence. This circumstance provokes Dunlap to contend that efforts "to base psychology on the physiology of the brain have been sadly disappointing" (9). What is known of the relationship of brain to intelligence may be expressed very briefly in the following paragraphs.

Comparative neurology tells us that the brains of animals and men differ in complexity roughly as animals and men differ in complexity of behavior possibilities. The evolution of the human brain, according to Berry and Gordon, comprises five stages of development:

"1. The spinal cord activities of the reflex arcs.

"2. The medullary-pontine levels of the vital reflexes of circulation, respiration, etc.

"3. The thalamo-striate brain, the human and modified equivalent of the reptilian end-brain of reptilian 'emotions.'

"4. The infra-granular cortex of the mammalian brain with its animal functions, and instinctive behavioral reactions.

"5. The human supra-granular brain of educability, control, integration, and discrimination.

"All mental defectives suffer from an underdevelopment of the fifth and highest of these 'brain' levels, with a consequent transference or atavistic reversion of their mental processes to lower and more primitive ones" (3).

These levels may be noted in the diagram below, Figure 29.

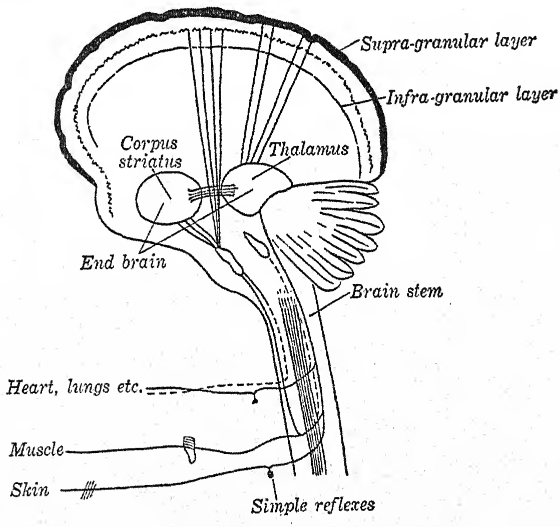


Fig. 29
(After Berry and Gordon)

Intelligence is primarily related to the fifth or final stage of development—a fact revealed from post-mortem analysis of the brains of mental defectives. This analy-

sis demonstrates a definite relationship between thickness of the cortical layers of the cerebrum and levels of intelligence. In the case of the lower grades of feeblemindedness, the infra-granular layer (animal functions) is much thicker than the supra-granular layer (intellectual functions). Figure 30 graphically portrays the relative thicknesses of cortical layers in the case of the normal, the supernormal, and the subnormal.

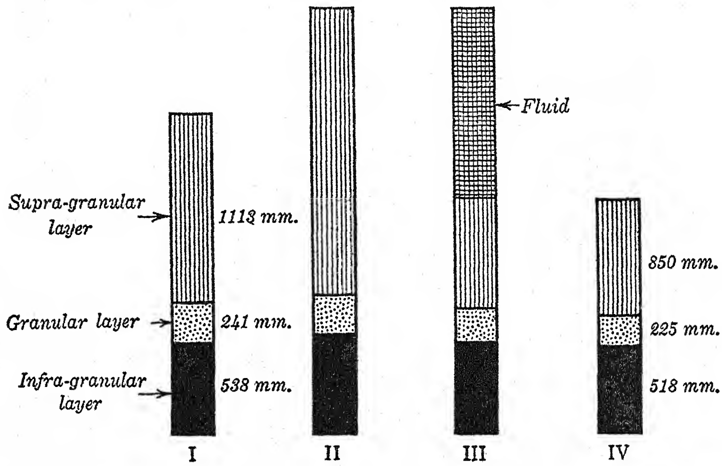


Fig. 30

I. Normal adult. III. Macrocephalic subnormal.
II. Macrocephalic genius. IV. Microcephalic subnormal.

Diagram to show the proportions of cortical layers for four levels of intelligence. (After Berry and Gordon)

These differences may be revealed externally in size of head. Mental deficiency is frequently associated with very small heads and very large heads, the former called *microcephalic,* the latter *macrocephalic.* Berry and Gordon estimate that two-thirds of mental defectives are microcephalic.

The primary neurological condition of intelligence appears, then, to be a matter of quantity of brain cells, par-

ticularly in the cortical area. This would suggest that weight of brain is a criterion of intelligence. However, brain weight, as brain size, varies widely within the range of normal intelligence. The average weight of the human adult male brain is 1400 grams, that of the female 1300 grams. Yet the brain of Anatole France weighed but 1017 grams (55); that of Liebig, the famous chemist, 1352 grams; that of Thackeray, 1644 grams; that of Daniel Webster, 1516 grams; and that of Curie, 1830 grams (8).

From an evolutionary viewpoint, a rough index of intelligence is observed in the ratio of brain weight to body weight. Table XV gives typical ratios.

Table XV.—Ratios of Brain Weight to Body Weight
[After Wheeler (56)]

Animal	*Body Weight* (*Brain* = 1)
Whale	10,000
Hippopotamus	3,000
Horse	500
Large dog	400
Gorilla	250
Cat	110
Squirrel	80
Monkey	50
Man	50

A secondary neurological condition is that of deficiency of cell nutrition. It is known, for example, that mental dullness is commonly associated with hookworm disease. In such cases, the hookworm parasite sustains itself on the hemoglobin of the blood, thereby depriving the brain cells of the oxygen necessary to cell growth. If the disease, however, is recognized very early, and the infection checked, the child's intelligence level may be raised from dull to normal (2). In this connection, it is important to note that numerous studies of undernourished children show no correlation between malnutrition

and intelligence level, except that in the case of those already dull or feeble-minded, malnutrition tends to lower the level still further (2, 36). But there is no evidence that a corrective diet will ever raise the I.Q.

More uncommon neurological conditions are those which pertain to retardation as a result of *birth injuries* —caused either by prolonged labor or by instrumental delivery, and as a result of *postnatal infections*, such as meningitis, encephalitis, and infantile paralysis. Numerous investigations of crippled children point to a marked relationship between paralysis and low I.Q., with occasional instances of very high I.Q.

Glandular conditions.—Although the study of the glandular mechanisms and functions (endocrinology) is of very recent development, a noteworthy contribution to an understanding of the physiological conditions of intelligence is already available.

The most serious type of glandular defect, from the standpoint of intelligence, is that known as *cretinism.* In cases of this sort, the *thyroid* gland has either not developed at all or has failed to function. Consequently, the intellectual growth is arrested, and the subject, unless treated very early, seldom attains a level above that of an idiot. In cases where the defect is discovered within the first year of the child's life, treatment with extract of sheep's thyroid, or the chemical product thyroxine, will effect improvement. Some cases, however, do not respond to treatment at all (31).

Less serious types, *hypothyroidism* and *hyperthyroidism,* appear not to be correlated with level of intelligence. In a comparative study of goitrous and non-goitrous children in the public schools of Cincinnati, it was found that goiter had nothing to do with intelligence (29).

Miscellaneous defects and illnesses.—Studies of the effects of adenoids and diseased tonsils show a zero correlation between these defects and I.Q. For example,

in a group of boys (530) of ages six to fourteen from the public schools of New York City, 236 had diseased tonsils sufficiently severe to warrant operative removal. The I.Q.'s of the tonsil cases were found to differ in no way from those whose tonsils were not diseased. And the I.Q.'s show no rise on the part of tonsil cases when the latter are retested six to twelve months after operation (17, 30, 37).

Terman has gathered data respecting the incidence of various ailments within a gifted group of children (I.Q. 130-200) and a control group, not especially gifted (48). These data, summarized in Figures 31 and 32, reveal the fact that ailments of the sort listed have no significantly detrimental influence upon the intelligence of children.

With the exceptions of the severe types of brain and glandular deficiency, it is safe to conclude that bodily defects and ailments bear no significant relationship to intelligence in any direct way. What effect these conditions may have upon the personality in inducing feelings of inferiority is a question to be considered in a later chapter. But so far as the popular idea that a sound body is necessary to a sound mind is concerned, this idea, and the one that the studiously inclined are apt to be physically weak, has little foundation. Whatever Shakespeare meant by that immortal line, "Sicklied o'er with the pale cast of thought," is a debatable matter; at any rate, it is far from being universally true that the thoughtful (intelligent?) are "sicklied."

Age.—In the discussion of the growth of intelligence, it was pointed out that differentiation of intelligence levels in terms of mental age is not possible beyond the teens, but that beyond this period of life the differentiations are expressible only in terms of relative position in a group, exclusive of age; hence the use of percentiles, deciles, and so forth. Again, in this discussion, it was

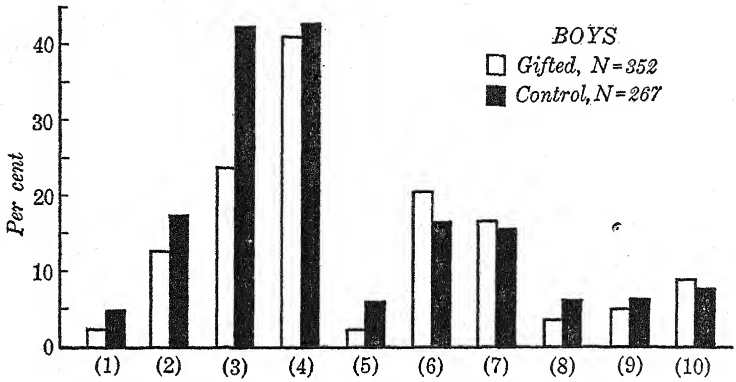


FIG. 31
(After Terman)

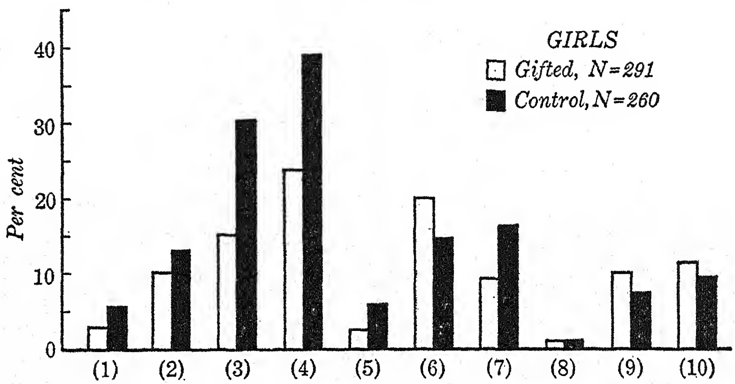


FIG. 32
(After Terman)

(1) Frequent headaches.
(2) Symptoms of general weakness.
(3) Mouth breathers.
(4) Colds occasionally or often.
(5) Poor or very poor hearing.
(6) Vision somewhat defective or poor.
(7) Nervous.
(8) Speech defects.
(9) Exceptionally timid.
(10) Tendency to worry.

pointed out that beyond the decade of the twenties the curve of intelligence slowly drops with increasing age.

In the present section our problem concerns the factor of age as a condition of intelligence as instanced in ability to learn. A widespread popular opinion expresses

the conviction that "you can't teach an old dog new tricks." This conviction presents a virtual challenge to psychology by way of calling for affirmation, denial, or some qualification.

Fortunately, a number of investigations have brought forth some illuminating data upon this problem. One of these, by Thorndike and collaborators, tested a group of forty-eight university students whose ages ranged from 20 to 57, and equated in intelligence upon the basis of CAVD scores. The test material involved a previous mastery of *Esperanto*—chosen for its newness, so far as the group was concerned, and also for its representative character as organized intellectual knowledge. The teaching and the amount of time devoted to study were the same for each person.

The results may be summarized as follows:

Group I (18), ages 20-25 gained 31.5 points.
Group II (9), ages 26-34 gained 26.3 points.
Group III (21), ages 35-57 gained 24.7 points.

The superiority of the youngest group was on oral directions only. In three other tests of ability no real

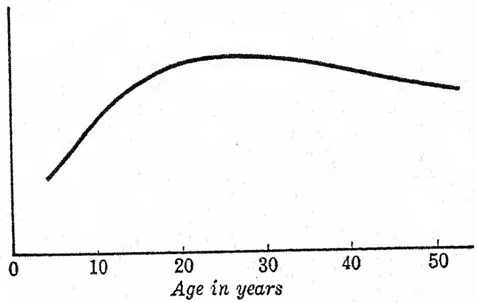


FIG. 33
[After Thorndike, *et al* (49)]

differences were found (49). Figure 33 shows the curve of learning in relation to age.

A non-experimental study of the relation of age to intelligence employs age of masterpiece production as a criterion of intellectual efficiency. This study was also made by Thorndike (51). Choosing impartially 331 names from the *Dictionary of National Biography,* he found the average "masterpiece age" to be 47.4. However, there were ten scientists whose *magnum opus* was achieved beyond the age of 70, and six, beyond the age of 80. From a selection of forty-six of the most eminent English writers from Chaucer to Matthew Arnold, who lived to 70 and beyond, Thorndike discovered the median "masterpiece age" to be 47, the same as in the group above.

On the question, then, of intelligence and age, the conclusion of Thorndike, as based on a wide survey of studies, may well be presented.

> "Such few age differences as do appear are usually explainable as the products or symptoms of special experiences associated with age rather than as products or symptoms of a general inner change in the mind's ways of working. If we had a hundred boys of sixteen and a hundred men of thirty-six study algebra or French or history or civics for a year and had a record of the thinking of each individual in doing so, I very much doubt whether we could do much better than guess at which was young thinking and which was old thinking, except for references to special adult experiences or signs of special interests" (50).

He further concludes that no one under the age of forty-five needs to quit learning on account of a fear that one is too old to learn. In general, adults from ages twenty-five to forty-five will learn as readily as they did at fifteen to twenty. The main requisites for success in adult learning are capacity in terms of intelligence level, interest, energy, and time (52).

SUMMARY OF THE CHAPTER

In order to explain intelligence as an aspect of human behavior, it was necessary, first of all, to look into the problem of heredity and environment, inasmuch as this problem includes the question as to whether or not intelligence is something "innate" or "acquired." We noted that this problem and this question were somewhat compromised by being envisaged in antithetical terms. It therefore became necessary to turn to experimental data as the means whereby valid conclusions could alone be drawn. From the science of genetics we discover the hereditary basis of intelligence to consist of protoplasmic factors called genes. But intelligence is not alone a matter of genes, for genetics tells us that no characteristic can appear without favorable environmental conditions. Hence the entire problem of intelligence needs to be redefined in such a manner as to provide a basis for investigation of the conditions which produce intelligence. However, experimental manipulation of human beings by cross-breeding is entirely out of the question; one is therefore limited to statistical methods of experimentation as these involve the study of individuals of varying genetic constitution under varying environmental circumstances.

Six conditions of intelligence were then taken up in order. The first, mode of genesis, concerned the relative effects of similarity and dissimilarity of genetic make-up. Identical twins appear to differ from each other under varying environmental backgrounds no more and no less on the average than does a single individual on retests. This, and other evidence, namely, that the correlations vary directly with degree of genetic relationship, leads strongly to the conclusion that hereditary constitution is the chief condition of intelligence. In view, however, of the consideration that measures of environment cannot

possibly take into account *all* factors, there may be potent environmental factors nonetheless. Granted that such factors are speculative, the conclusion nevertheless is that both types of conditions—hereditary and environmental—are inseparable, for one cannot tell from the effects produced which is which.

As for the second type of condition, sex, we find no essential differences which would determine one sex to be superior to the other.

With regard to race, we noted that negroes and American Indians are invariably inferior to white peoples, especially on verbal tests and by reference to white norms. But before valid conclusions can be drawn a great many more investigations upon racial psychology need to be made, with particular regard to equalization of test conditions.

Data in respect to social-occupational background show a uniform tendency for high intelligence to go with the higher occupations, and vice versa. But exceptions occur and should be emphasized. In the case of foster-children the I.Q. appears to respond to change of environment, particularly the better type of home and foster-parent, and also when the child is removed to the better home at an early age. Again, it appears that, in view of the large incidence of subnormality among the natural parents, and the relatively small incidence of subnormality among their children, the conclusion is warranted that effects produced in one case by heredity may in another case be produced by environment.

Physiological conditions pertain directly to the brain and nervous system in terms of cellular quantity and cellular nutrition. The thyroid gland is also a factor in so far as extreme deficiency of function is responsible for feeble-mindedness. Birth injuries and postnatal infections are of some significance inasmuch as they involve the central nervous system. Other ailments, as

far as investigations have gone, show no influence upon intelligence.

Finally, age was found to be in itself not an essential factor. Other things being equal, ability to learn is a matter of I.Q.

QUESTIONS FOR DISCUSSION

1. How would you express the distinction of the two meanings of heredity? Illustrate.
2. Summarize the experimental findings of genetics.
3. Of what importance are these findings for the problem of intelligence?
4. Why must psychology have recourse to statistical methods in solving the problem of inheritance?
5. What is the importance of identical twins for studies of inheritance?
6. Summarize the data obtained from testing children of varying degrees of relationship.
7. Elaborate upon Jennings' summing-up of the data.
8. What inferences would you draw from the data on sex as a condition of intelligence?
9. What would be your conclusions on the question of racial differences?
10. How would you answer Taussig's questions?
11. In view of Cattell's study would it be fair to infer a person's intelligence level from his occupational level? Why, or why not?
12. What inferences would you draw from Kawin's study?
13. Summarize and evaluate the findings of Freeman's and Burks' studies.
14. Give the gist of the neurological conditions of intelligence.
15. Why would a corrective diet in cases of malnutrition prove ineffective so far as I.Q. is concerned?
16. What is the relationship of the thyroid gland to intelligence?
17. Summarize the data on age as a condition of intelligence.

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CHAPTER VII

PRACTICAL AND THEORETICAL ASPECTS OF INTELLIGENCE TESTING

FROM the vantage point of acquaintance with the origin and development of intelligence-testing and with the conditioning factors of intelligence, one may now see more clearly the enormous practical importance of psychological testing. This chapter, accordingly, will first of all set forth the primary uses of tests in schools, industrial organizations, juvenile courts, and other social agencies; it will then take notice of certain social implications of intelligence-testing, and will finally consider some current theoretical points at issue.

SOME USES OF INTELLIGENCE TESTS

In the discussion of the origination of the intelligence test, we saw that Binet's prime concern was to develop a practical technique for discriminating degrees of educability. This concern, indeed, has continued through the years to be the dominant one in all applications of tests. We took cognizance of the fact also that this concern somehow shaped the conception of intelligence as a facility with tasks, predominantly verbal and abstract, and thus led to the identification of general intelligence with intellectual activities.

The school.—Under such formative circumstances, the intelligence test would naturally find major application in the school. Here, in fact, the most fruitful results have so far been obtained. To arrange the materials, as well as the environmental conditions of learning, upon

the basis of the individual capabilities of children, as reliably determined by tests, is to provide for the children opportunity for maximum development of those capabilities. Today, it is perfectly safe for psychologists to claim that the most scrutinizing survey of educational procedures, since the inception of the intelligence test, would reveal an astonishing achievement in efficacy of instruction and in improvement of pupil attitude by reason largely of adaptability of instructional procedure to individual aptitude.

A challenging question may be raised, of course, as to whether or not the tests have really superseded teacher judgments of pupil capability. Here one may recall the fact that Binet sought to validate his tests upon such judgments. Does not this fact then prove the tests superfluous? And the answer would be that a composite of teacher judgments does indeed furnish a reliable index of pupil capability, but that a single judgment is likely to err considerably in the case of a given pupil. The reason is that an individual teacher is apt to judge in terms of subjective criteria. When, however, a group of teachers *pool their judgments by reference to an agreed standard of ability,* the resulting composite judgment provides a fairly accurate estimate (4). Nevertheless, an intelligence test does become in large measure a substitute for teacher judgments inasmuch as it represents a diagnostic instrument that is both convenient and highly objective.

Throughout the entire range of school instruction, the intelligence test serves as an instrument of guidance. Obviously enough, since there are differentiable levels of capability within a given age, there ought to be differentiable levels of instruction. Educators have long been aware of this. Yet it was not until the tests had reached a fair degree of reliability that educators could adopt a competent means for effecting differentiation. Now the

sectioning of pupils on the basis of capability is, from kindergarten to college, the order of the day; however, it should be remarked that mere sectioning is by no means the panacea for all pedagogical ills. Other factors, besides I.Q., must be considered, such as qualities of character, responsiveness to other persons, and so forth (7).

Moreover, the intelligence test provides a basis for determining whether a given pupil should continue his education through the academic high school and through college, or whether he should enter a vocational school. In view of the fact that success in life does not altogether depend upon facility with abstract materials but may well depend upon facility in manipulating objects or in making social contacts, it is of utmost importance to the individual that he be guided fairly early in his school career toward the occupational level for which his intelligence type and level are adequate. To be sure, this sort of guidance implies an effectively established program of social service. And for this program, the psychologist is the one to supply the needful experimental data.

It is known, for example, that children of I.Q.'s below 50 cannot be taught the rudiments of education as embodied in the three *R*'s. Children of I.Q.'s below 70 cannot master the materials of the fifth grade; although they may be "pushed through" to the eighth grade for any one of several reasons other than the essential one of subject-mastery. No pupil whose I.Q. falls below 90 should attempt to go through high school (2). And for numerous subjects on this level of curricular attainment, a minimum I.Q. of 110 is necessary for mastery (8). On the college level, as previously noted, a *critical score* of some designated percentile is often specified as a basis for admission, for it almost invariably happens that freshman failures concentrate in the lowest ten percentiles.

Dunlap has remarked that a test devised for college entrance is, strictly speaking, a *trade test* (3). Thus to designate a test of academic capability may appear anomalous, but is nevertheless indisputable. A liberal arts preparation, however broad it may be, is virtually a preparation for an academic career—a career requiring abstract intelligence *par excellence.*

Industrial organizations.—The mention of trade tests suggests the practicability of a program of testing for industrial and business purposes. In this connection it should be emphasized that a low rating on a test of general intelligence is by no means an augury of failure in life. The truth is that tests of general intelligence have proved of little, if any, value for many vocations (15). In cases of low ratings on such a test, the sensible thing for an individual to do is to locate his aptitudes by taking a variety of trade tests. Many of these have been standardized and are now available (16). A mechanical ability test, as illustrated in the Minnesota battery, will provide a basis upon which to counsel an applicant and in terms of which one may suggest the specific aptitude indicated by the scores.

In a broad way, however, tests of general intelligence provide useful indices of capability for various occupational levels and thus may serve as the initial agency for steering individuals toward the appropriate level.

The courts.—It is popularly supposed that delinquents and criminals are below normal intelligence. The psychological evidence, however, does not support this notion. From extensive testing of prisoners in penitentiaries many are discovered who rank high in intelligence. Many prisoners and other delinquents, in truth, do have low I.Q.'s; yet it should be emphasized that a great deal of test data has been obtained from prisons and reformatories whose inmates may not be typical of the criminal class at large. The majority of inmates may have been

caught and incarcerated because they are not bright enough to evade the drag-net of the law.

Nevertheless, there is some evidence to show that intelligence level relates in a general way to type of offense. Crimes involving forgery and other forms of fraud seem to be committed by persons who are above average in intelligence. Crimes of sex tend to be committed by persons below average (6).

Psychological tests are frequently given at the request of juvenile court jurists, partly to determine intellectual sense of responsibility and partly to furnish guidance in the disposition of the offender. In this regard, the psychologist coöperates with the psychiatrist and the probation officer with a view to the best possible solution for the interests both of the delinquent and of society (9).

Other social agencies.—The studies of foster-children, referred to in the preceding chapter, suggest the possibilities of using intelligence tests in the selection of children for adoption. The fact that foster-parents seldom specify intelligence in making a selection demonstrates the need for enlightenment on their part respecting the desirability of testing. Doubtless, it may be said, a significant amount of subsequent disappointment could be forestalled if the needful information were obtained in advance of selection. Even granted the possibility that tests on the level of infancy may lack sufficient refinement for accurate diagnosis, at least they are adequate for purposes of detecting probable subnormality. And to do this much would be of inestimable value.

Intelligence tests have also found fruitful application at immigrant-receiving stations (5). Today, doubtless, the problem of selection, here, is not as acute as in the past, on account of restrictive laws. However, the problem may reassert itself in the future with the accompanying need for psychological methods of determining an immigrant's adaptability to social requirements.

WHAT INTELLIGENCE TESTING MEANS TO SOCIETY

In spite of the values accruing to the individual and to society from the effective use of intelligence tests, there is a widespread belief that an educational program, based upon I.Q. differences, would be contrary to the democratic principle of equality, and therefore inimical to the public weal. This belief is often expressed in terms of a resentment (based on fear) respecting any trend toward an "intellectual aristocracy." Quite recently, this resentment took conspicuous form in political circles through caricature of a "brain trust." But disregarding the possible political motive of discrediting the party in power, it would be well for us to consider the logicality (or illogicality) of the popular interpretation of democratic equality in so far as it concerns individual capabilities.

In the first place, an enlightened view of the meaning of the famous clause in the *Declaration of Independence* considers the "equality" therein specified to refer exclusively to political, social, and religious equality. Hence to expand the term "equality" to include intelligence is to misconceive the intention of the framers of the document. As a *voter,* the moron with an I.Q. of 65 is equal to the genius with an I.Q. of 165. Of course, one may well claim that even as voters the two are far from equal in comprehension of the qualifications of candidates, significance of issues, and responsibilities of citizenship. Notwithstanding this claim, the vote of the moron is *numerically* equal to that of the genius—and this expresses the principle of democracy.

The framers of the *Declaration* knew of idiots and imbeciles and doubtless took for granted that these grades of intelligence would create no problem for a democratic order of society; but they knew nothing of high-grade morons and the dull who, to ordinary observation, are

indistinguishable from the average citizen. Binet was a hundred and thirty years in the future.

In the second place, no political or religious or educational dictum can provide equality of opportunity in disregard of level of capability. Certainly, intelligence tests have not created the I.Q. levels of the population; they have merely revealed these levels. It follows, therefore, that instead of denying opportunity to many individuals, the tests lead inevitably to the adoption of a socio-educational program which shall be pregnant with opportunity *at the level of individual capability.* Hence no greater boon could come to a democracy than the effectively-worked-out program of providing for each member of the social order those possibilities of individual development consonant with individual aptitude. Indeed, upon such a program alone may democracy consummate its intention to allow to each individual maximum opportunity for the pursuit of happiness.

Accordingly, the immediate social program calls for the fullest utilization of the knowledge gained from intelligence testing to the end of discovering for each person his "profile" of assets and liabilities, in terms of aptitudes—music, literary ability, social leadership, mechanical ingenuity, and so on. For the rising generation, this program is imperative as a means of forestalling further social wreckage through misfits in occupation with their frequent anti-social consequences. For the adults, who find it necessary to realign their vocational outlook by reason of unemployment or technological changes, the program will include effective counseling upon the sound basis of test data. To repeat Thorndike's conclusion, based upon wide research into the problem of adult learning—no one under the age of forty-five needs to fear that he is too old to learn, for adaptability to the new is not so much a matter of age as it is of capability, interest, energy, and time (12).

As the program suggested above enlarges with increasing psychological achievement in research, the traditional, but psychologically discredited, method of *laissez-faire* selection will give place to a scientifically grounded plan of vocational selection. In the present connection, it should be remarked that possession of a high I.Q. unfits a person for numerous types of occupation, particularly those of a routine and monotonous character. For instance, the discovery has been made that labor turnover on low-grade jobs is far greater among persons of high intelligence scores than among persons of low or even medium scores, and that irregularity and inefficiency of production on such jobs is greater among the former than among the latter (17). Obviously, such conditions are symptomatic of boredom and restlessness.

On the other hand, an effective social program will provide adequate opportunity for those persons whose I.Q.'s prove their incapacity for any activity demanding insight and intellectual agility. The lowest grades of feeble-mindedness present no sociological problem other than that of economy of institutionalization. But the higher grades, including the dull and border-line cases, do present a very real problem (1). Practically all skilled trades are closed to them. Hence they gravitate, if not usefully employed in unskilled jobs, to vagrancy, vice, and crime. And since Nature, in her generous mood, bestows the gift of prolific procreation upon the "unfit" as well as upon the "fit" (save the idiots, who are practically sterile), the future of society becomes of paramount concern to the "fit." As a responsible authority puts the matter, "There is the inherent tendency of an insufficiently checked and increasing incidence of mental defect to turn an A1 into a C3 nation, and something of this sort appears now to be in operation" (1).

All of which raises the issue of eugenic control, an issue which reflects the question as to the relative potency of

heredity and environment. But this question has been disposed of through recognition of the fact that it is not a question of *either* heredity *or* environment, nor is it a question of how much heredity or how much environment. Since a given characteristic may be produced by the one or the other by inseparable interaction, the question cannot be answered. But if one must use alternatives, one should at least say that heredity is conditioned by environment, and environment by heredity.

Thus, from all that is at present known through genetic research and through psychological testing, one could not build a socio-educational program upon the belief that the child can "lift himself by his bootstraps" or upon the belief that the teacher can "make a silk purse out of a sow's ear." Terman may be right in likening "the developing child to a sponge—a growing sponge that is gradually increasing its capacity for absorption. At any given time the sponge will absorb only a certain amount of water even if you cast it into the ocean. In the case of the child, absorptive capacity seems largely determined by general mental level" (11). Or, to change the analogy, the efficacy of vitamin ratios is conditioned by metabolism.

Still, if a child's I.Q. can be raised by five to twenty points, however rare such cases, it certainly becomes obligatory upon society to seek to improve conditions to the limit, even though society does not know what that limit is for a given child. For, again, the evidence is clear that environment conditions heredity, if only, as Burks suggests, to "permit" inherited characters to assert themselves. And we do know that *intelligence itself manipulates the environment*—on the lower levels by retention of unfavorable circumstances, as in cases of moral and physical degeneracy, and on the higher levels by transformation of conditions for some purpose, as in the im-

provement of educational methods for meeting the very demands of intelligence itself.

Finally, to return to the matter of an "intellectual aristocracy," it is pertinent to observe how high intelligence and leadership tend markedly to go together. The agile intellect, in whatever scheme of human relationship, gains a footing in advance of its fellows. And despite the alleged fear of "brains," the democracy does provide for this sort of aristocracy and cannot get along without it. In this connection, the figure below is significant.

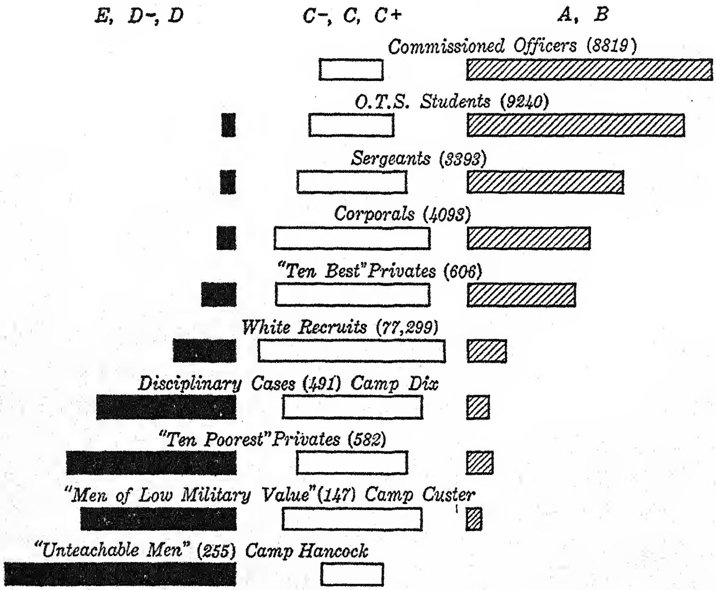

FIG. 34
(After Yoakum and Yerkes)

SOME THEORETICAL CONSIDERATIONS

By way of a brief résumé, this section will present the leading theoretical viewpoints taken by contemporary psychologists on the problem of intelligence. Following Spearman's excellent treatment, these viewpoints may be summarized under four headings or "doctrines" (10).

The monarchic doctrine.—Here the view is expressed that intelligence is a "single sovereign power" over and above its multifarious manifestations, a sort of unitary something which pervades all intellectual functions but which neglects to discriminate these functions as separable aspects. Hence tests of "general" intelligence, based upon this viewpoint, involve the fallacious procedure of *averaging* scores on tests of more or less disparate functions—for example, verbal items and arithmetical items. This procedure, it is claimed, is comparable to averaging apples and potatoes.

The oligarchic doctrine.—This particular doctrine reflects the traditional "faculty" psychology by assuming intelligence to comprise a number of discrete entities, such as judgment, invention, memory, attention, etc., each separably measurable by tests, the scores of which, when tabulated, show the relative "amounts" of each function which the particular individual possesses. In criticism of this theory, one should recall the *fallacy of naming* whereby the act of designation assumes a corresponding "thing." Accordingly, the test scores, as indices of intelligence, are quite arbitrary.

The anarchic doctrine.—In its original crude form this doctrine maintained that intelligence is just a name to symbolize many different and separable intellectual functions or abilities, each of which could be designated an intelligence. Examples of these abilities are memory for digits, ability to add, to subtract, to multiply, vocabulary, ability to give opposites, ability to judge lengths of lines, and so on *ad infinitum.*

This conception of intelligence, however, became modified through the adoption of methods of correlation, and the ensuing discovery that numbers of these abilities tended to "hang together." This discovery led to the postulation of common or "identical" elements. Accordingly, tests of intelligence undertook to "sample" these

abilities, and to express results in terms of averages or levels of ability. But, according to Spearman, this doctrine has the glaring deficiency of being unable to tell whether or not the *statistical* average is truly representative of the person's *real* abilities.

The two-factor, or eclectic, doctrine.—This represents Spearman's own theory, based upon exhaustive studies of correlations obtained from a multiplicity of test data. These studies indicate to Spearman the necessity for interpreting intelligence as involving a *general factor* (*g*) and a *specific factor* (*s*). The *g* is the common element found in tests of numerous specific functions. Although Spearman conceives the *g* to be a form of energy, he is careful to state that it is not a "thing" but a "value," which is found in all measurements of intellectual activities. By contradistinction, *s* is the specific function as tested, such as discrimination of pitch, naming of opposites, and so forth.

So, then, for each individual the *g* remains the same throughout all correlated abilities, but varying from individual to individual. The *s*, however, varies from individual to individual, and from ability to ability for the same person. Moreover, the relative influences of *g* and *s* vary from ability to ability. For example, Spearman found, by application of mathematical formulas, that the ratio of *g* to *s* in the case of *ability in the classics* was fifteen to one, while for *musical ability* the ratio was one to four.

But many *s*'s are so nearly alike as to constitute considerable overlapping; in which case they may be regarded as *group factors*. It is known, for example, that a high vocabulary score correlates almost perfectly in the positive direction with other scores involving verbal materials; so that from vocabulary score alone one can safely predict other verbal abilities of a given individual. The same is true of abilities grouped as arithmetical.

Accordingly, the problem confronting psychology is the determination by correlation of what abilities do "hang together" and what abilities do not. When this problem is solved, in respect to a great number of specific abilities, the possibility of predicting an individual's "profile" of intelligence from one or two test samples will have been placed on a sound mathematical basis.

At present, however, there is no agreement among psychologists upon the hypothesis that intelligence is definable in terms of *g* and *s*. Some are of the opinion that the recognition of a number of "group factors" is sufficient for all practical purposes of intelligence testing. According to Thurstone, "Since all mental tests are positively correlated, it is possible to describe the intercorrelations in terms of several factors in such a manner that one of the factors will be conspicuous in comparison with the others" (14). Thurstone's conclusions, based on complicated mathematical deductions, indicate that abilities as measured by tests arrange themselves in "clusters" or "constellations." One of these constellations he discovers to exhibit the general factor of *verbal ability,* another the factor of *manipulative ability,* still another the factor of *visual form perception,* and so on.

In view of all this ferment of psychological theorizing, one is impressed by the necessity for the utmost caution in arriving at conclusions. But whatever the conclusions at any stage of scientific progress, they are inevitably tentative. New data, new methods of attack, fresh insights leading to new formulations of problems—all these exhibit the vitality of a young science as well as the enormous frontage of its line of operations.

Meanwhile, despite patent defects both of theory and of technique, the program of intelligence-testing finds justification upon the pragmatic assurance of educational, sociological, vocational, and other achievements in the workaday world. As time goes on, these defects,

while perhaps not crucial in practical life, will doubtless be corrected in the interest of both theory and practice.

SUMMARY OF THE CHAPTER

We have seen that intelligence-testing began as an educational enterprise and was therefore molded along academic lines, as observed in the preponderance of verbal material in the early construction of tests. By and large, the testing has served the primary purpose of determining levels of ability for pedagogical classification. In this regard, the tests provide an objective and reliable substitute for personal judgments.

Applications of testing for industrial purposes eventually took form. Here, the tests of general intelligence are found to be useful only in the sense of broadly indicating occupational level. Beyond this purpose, the tests of specific abilities, chiefly mechanical in content, are needful for direct counseling.

For the courts, and other social agencies, the intelligence test finds direct application for purposes of diagnosing intellectual level in its relation to personal and social responsibility. Hence every juvenile court, in particular, should provide psychological service for obvious reasons.

As for the social implications of intelligence testing, we noted that equality of capability has nothing to do with equality in a political sense, but rather expresses a mythical conception of democracy. The social importance of intelligence-testing is seen, directly one understands how by this means the mentally incapable are detected, thereby providing for society an instrument for its own protection as well as that of the subnormal himself. Furthermore, by revealing to an individual what his aptitudes are, the tests become an agency for suggesting ways of preventing vocational and social misfits. Accordingly, for its own welfare, it becomes the inescap-

able duty of society to provide the conditions which make for the blossoming rather than the stifling of individual ability.

Finally, we took cognizance of certain theoretical aspects of intelligence testing under the rubrics of the four doctrines. Careful scrutiny discloses the deficiencies of each of these doctrines, mainly with respect to their bases of interpretations. In brief, the present theoretical problem of the psychology of intelligence finds formulation in statistical terms, the outcome of which, whether to affirm or to deny the presence of "group factors," depends upon further extensive investigations.

But all this leaves the practical benefits of intelligence-testing undiminished. Fortunately, indeed, the practical program need not wait altogether upon theoretical refinements, though it undoubtedly will be modified as these refinements are appropriated.

QUESTIONS FOR DISCUSSION

1. What other factors than that of I.Q. are important for success in school subjects?
2. Mention a number of advantages and disadvantages from sectioning pupils according to I.Q.
3. Discuss the practicability of selecting employees by test.
4. What advantages might accrue to society and to the delinquent from the use of tests in court procedures?
5. Discuss the significance of test results for the maintenance of a democratic order.
6. Interpret the diagram on page 232.
7. Summarize the theories of intelligence.
8. How are constellations of abilities determined?

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PART III

THE PSYCHOLOGY OF FEELING AND EMOTION

CHAPTER VIII

EMOTIONAL BEHAVIOR—FIRST SECTION

Everyone recognizes the dominance of feeling and emotion in everyday life. One knows from direct experience that life and feeling are inseparable, whether it be the exhilaration attendant upon rising in the morning, or the converse feeling of depression, whether it be the rapture welling up during the performance of a symphony orchestra, the variation of mood as a play develops in plot and climax, the empathic perturbation wrought up at a movie, or the crippling embarrassment ensuing upon a humiliating incident. Indeed, one could say with a great measure of certitude that life *is* feeling. One's everyday vocabulary is replete with terms denoting feelings: happy, sorry, fearful, hilarious, grief-stricken, hateful, melancholic, nauseous, elated, agitated, boresome, thrilling, yearning, indignant, amazing, horrid, tender, and so on.

Certainly, psychologists are pretty well agreed that in everyday thought and action feeling and emotion take precedence over and, to no mean degree, actually regulate one's intellectual processes; all of which, be it remarked, does not accord with one's self-conceit. Yet if one should take pains to observe the behavior of men, including oneself, one would be constrained to agree that the psychologists in this respect have approximated the truth very closely indeed.

In particular, one may consider how governments incite patriotic sacrifice through propaganda of enemy "atrocities"; how the politician appeals directly to

pocketbook, stomach, and family security; the ready responsiveness of people to racial and religious prejudices, to appeals to "take justice into your own hands," and to buy beyond means in order to "keep up with the Joneses"; not to mention the more precipitate feelings of antipathy by which one's estimates of acquaintances are colored, or the irresistible feeling of infatuation whereby one *falls* into love, or that anticipatory mortification which compels one to cross the street to avoid the inevitable snub, or those cramping effects of nostalgia. Assuredly, these do but typify those incidents of life which force one to recognize that intellect is not so much the lord and master of behavior as are feeling and emotion.

But in spite of all their obtrusiveness, feeling and emotion present to psychology a far from simple problem of analysis and explanation. In fact, not only has this problem long antedated the science of psychology, as in theme and argument of poetry, drama, and the novel, but even now continues to exercise the ingenuity of literary craftsmen to elucidate and resolve. For psychology, the problem is initially construed somewhat differently from that of literature. One may say that psychology's aim is to unravel the "why" and "wherefore" of emotion, that of literature to portray the embranglements of emotion in human affairs.

At any rate, our initial purpose must be to ascertain how psychology seeks the key to the comprehension of emotional behavior.

RELATION OF FEELING TO EMOTION

Sometimes it is held that emotion is just feeling gone violent, a view that is plausible enough when one observes how a feeling, say, of annoyance, passes over into the emotion of anger; for the latter seems just a more agitated mode of the former. However, the *conditions*

for the occurrence of emotion are often quite different from those for feeling. Partaking of a good meal, for instance, induces a feeling of satisfaction; but eating more and more of the same meal will not transform the feeling into the emotion of exultation. And a pleasant feeling, induced by a mild tickle, may suddenly change to an emotion of rage if the tickling is prolonged. In both instances some change of conditions has developed to effect the change in response.

Upon this question of difference, McDougall offers an interesting, and possibly valid, suggestion (17). He posits the view that feelings arise and are conditioned by the degrees of success and failure of one's own efforts, whereas emotions are aroused by some object or person deemed responsible for one's success or failure in some particular situation. On this view, a given feeling may vary from very slight to very intense without passing into an emotion at all. So then an emotion is not just a feeling gone violent but is itself a singular experience. For convenience of discussion, however, a sharp distinction between feeling and emotion need not be drawn; after all, their similarities, physiological and psychological, may be greater than their differences.

HOW PSYCHOLOGY EXPLAINS EMOTIONAL BEHAVIOR

Paradoxically enough, emotional behavior is both obscure and obtrusive; obscure, that is, to scientific scrutiny, obtrusive to calm analysis. Yet science need not thereby be daunted. Whatever is an aspect of nature is a problem for science. Everything in nature, therefore, is grist for the scientific mill if only appropriate techniques can be evolved for handling the particular grist. In what follows, accordingly, we may see what techniques have been employed in the endeavor to sift the grist of emotional behavior and what results have thereby been obtained.

The introspective technique.—It will be recalled from the first two chapters that the method of introspection was the one utilized in the early development of scientific psychology, a method by which the facts of consciousness could be sought out and classified. It will also be recalled that, despite the original atomistic implications of this method, it is really an indispensable means of securing data otherwise not ascertainable. Particularly is this true in the study of feelings. A description of a pain or of a feeling of comfortableness is a description of matters utterly private in nature; the description is just a symbolic transmutation of the feelings.

In describing a feeling, one suggests its character as of a condition somehow pervading the entire body. One feels, so to speak, all over. Again, by introspection, feelings appear in a *temporal* form. One may feel cheerful all the day long, or feel "blue" for an hour, or fluctuate rapidly from one mood to another.

It was by introspection that Wundt, the organizer of the first psychological laboratory, undertook the scientific analysis of feeling. From his analysis he concluded that feelings are classifiable into three pairs of "feeling elements": *pleasantness-unpleasantness, strain-relaxation,* and *excitement-calm.* In everyday experience these elements are compounded in all varieties and combinations and degrees (25). Subsequently, other experimenters, notably Titchener, discovered the last two pairs to be reducible to the single pair of pleasantness and unpleasantness (23).

Further experimentation by means of introspection disclosed these feeling elements as "pressures." Under strict laboratory conditions, for instance, a subject previously trained in the technique of introspecting is requested to describe his experience *as it is,* that is, without reference at all to the stimulus-source of the experience. Under these conditions, the subject reports that pleasant-

ness is a sort of "bright" pressure, unpleasantness a sort of "dull" pressure (20).

Still further experimentation revealed the location of these pressures. Bright pressure appears in the upper part of the body, especially about the neck and shoulders. Dull pressure appears in the region of the internal abdomen. These pressures are very elusive, however, for they vanish whenever the observer momentarily directs his attention away from the experience itself to the stimulus-source (24, 26).

Experiments of this sort are very pertinent to a discussion of feeling for two reasons: they admirably illustrate the introspective method, and they direct attention to the bodily conditions of feeling. It may be that by introspection alone the psychologist can never locate with precision the bodily components of feeling, because, as noted above, a very slight variation of the introspective attention loses the feeling. Even ordinary experience bears witness to the fact that upon any attempt to analyze a feeling or emotion, of anger for example, *that* feeling or emotion is no longer "there" to be analyzed. Instead, one finds oneself analyzing something else. Consequently, feelings and emotions have long been considered by many psychologists to be insuperably obscure for the introspective approach alone. Another line of attack has accordingly been opened up, namely, analysis of the *physiological* conditions.

The physiological technique.—In following this approach, psychologists have not discarded the data accumulated through introspective observation. As a matter of historical importance, both introspective and physiological methods have been employed since the beginning of experimental psychology. But only recently has our knowledge of the physiological mechanisms and functions advanced sufficiently to illuminate to a marked degree the problem of emotional behavior. Naturally

enough, in any historical survey of this problem, one would find a stage of progress where only a modicum of physiological evidence could be marshaled to confirm, to supplement, or to correct introspective conclusions. As this evidence accumulates, so do interpretations change or expand.

Darwin's explanation.—Darwin's well-known inquisitiveness as a naturalist led him to investigate the emotive behavior of both animal and human kind. His observations, keen as they could be, were not particularly of an experimental character, at least in the laboratory sense, but represented rather the sort of inductions obtainable by inspection of the gross behavior of animals and men under emotional excitement.

From these observations, he formulated three principles of explanation: (*a*) emotions are of the nature of *serviceable habits,* as for attack and defense—clenching the fist in anger, baring the teeth in rage; (*b*) emotions represent *antithetical action,* as illustrated in the "spitting" and "purring" of a cat; (*c*) emotions express an *"overflow" of nervous energy,* as exemplified in trembling, profuse sweating, involuntary micturition, and so forth (10).

These interpretations of Darwin, like his original theory of evolution, have necessarily undergone considerable modification in the light of subsequent biological evidence. Nevertheless, he "blazed a trail" in the study of emotion which led to fruitful investigations by successive observers, and for this he justly deserves recognition in any account of theories of emotion.

The James-Lange explanation.—Following upon Darwin's contribution is the theory of William James and Carl Lange. These investigators independently derived a new explanation of emotion from both introspective and physiological observations (14, 15). Since Lange's presentation is in all essentials the same as James', one

may take either as representative of the other. James, however, presents a more graphic account than does Lange.

Briefly, James' observations led him to dispute the common notion that an emotion, as a "state of mind," produces those bodily changes and disturbances which one associates with emotion; for example, the notion that one cries because one feels sad. James maintained the opposite, namely, that one feels sad because one cries, and one is afraid because one trembles. Such a view of emotion, one can be sure, met with considerable opposition and ridicule, chiefly on the ground of its being utterly contrary to "common sense." Still, in the realm of science, the mere fact of opposition to common sense carries little weight, if any; the chief consideration is the validity of the evidence.

Now, according to James, what actually happens in an emotional experience may be described as follows: one sees an object, say a bear, or one hears a growl; the bear, as seen and heard, is the source of stimuli which impinge upon one's sense organs—eye and ear; these stimuli travel to the brain as nerve impulses, there inducing, in some mysterious fashion, a perception; that is, the stimuli take on meaning; impulses are then transmitted to muscles, glands, and other internal organs, setting these in commotion; this commotion, in turn, is transmitted to the brain, and *then* the emotion fright is experienced.

To quote James: "The bodily changes follow directly the perception of the exciting fact, and our feeling of the same changes as they occur *is* the emotion." The whole complex of sensations, associations, and motor elements, only as directly felt, constitutes the emotion. So much so, James further contends, that if there are no bodily disturbances, there can be no emotion. To quote again: "If we fancy some strong emotion, and then try to abstract from our consciousness of it all the feelings of its bodily symptoms, we find we have nothing left behind,

no 'mind-stuff' out of which emotion can be constituted, and that a cold and neutral state of intellectual perception is all that remains." And again: "Can one fancy the state of rage and picture no ebullition in the chest, no flushing of the face, no dilation of the nostrils, no clenching of the teeth, no impulse to vigorous action, but in their stead limp muscles, calm breathing, and a placid face? . . . In like manner of grief: what would it be without its tears, its sobs, its suffocation of the heart, its pang in the breast-bone? A feelingless cognition that certain circumstances are deplorable, and nothing more. Every passion in turn tells the story. A purely disembodied emotion is a nonentity" (15). And from Lange: "We owe all the emotional side of our mental life, our joys and sorrows, our happy and unhappy hours, to our vasomotor system" (14).

After reading this delightful excerpt from James, one should remark that had it not been for James' prestige in the scientific world (and that of Lange, too), his extraordinary viewpoint would have been dismissed, if not altogether ignored, as pure literary extravaganza. What actually eventuated was a remarkable stimulation to physiological experiment in the hope of verifying or disproving the hypothesis.

The neurovisceral factors in emotional behavior.—In order to grasp the full import of the experiments, one must know, at least in an elementary way, certain essentials of the physiological mechanisms basic to emotional behavior. These details may be briefly described in the following paragraphs.

The entire nervous system comprises two subsystems known as the central nervous system—which includes the brain and spinal cord—and the autonomic nervous system. The central system is concerned chiefly with the activities of skeletal musculature of the body, the voluntary movements of arms, legs, head, and so on, as well as

the processes of thinking and willing. The autonomic system has chiefly to do with the involuntary functioning of the internal organs—the heart, lungs, liver, and so on. It is the autonomic system which governs the reactions of emotional expression. Figure 35 portrays the schematic outline of this system.

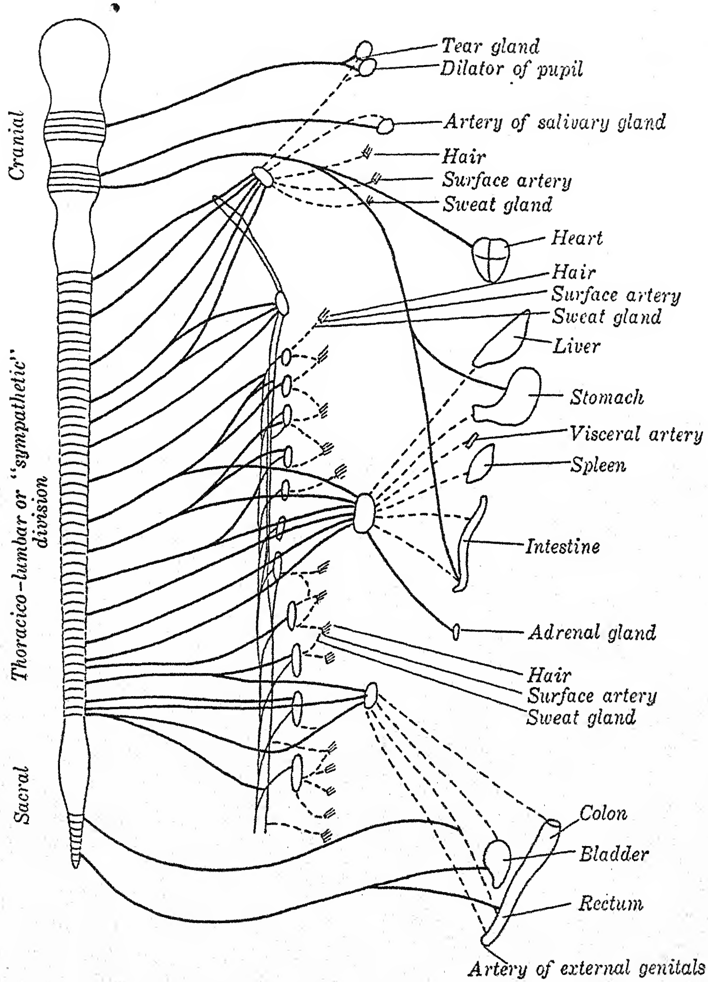

Fig. 35
(After Cannon)

The autonomic system is, in turn, divided into three functional groups of nerve connections: cranial, thoracic-lumbar, and sacral, corresponding roughly to head, chest, and abdomen. Sometimes these divisions are referred to as the *sympathetic* (thoracic-lumbar) and *parasympathetic* (cranial and sacral). The sympathetic division controls the small blood vessels of the abdominal organs, the skin, the heart, the sweat glands, the muscles of the stomach and intestines, the hairs, the liver, the spleen, the bronchioles, the pupils of the eyes, and the pelvic organs, as well as the medullary part of the adrenal glands. The numerous functions of this system, though diffuse, are a unified whole. They serve as mobilizing agencies for meeting emergencies of the organism, such as escape, defense, and attack. For these purposes energy is made available through increase of heat, acceleration of the heart and circulation, increased respiration and oxygenation of the blood, and maintenance of heat balance through perspiration. In addition, there is an increase of adrenal secretion which not only energizes the organism to a high degree but effects quicker coagulation of the blood so that it readily clots on exposure to air, thereby preventing weakness through loss of blood in case of injury.

The parasympathetic system is not organized to act as a whole, except as it is in functional opposition to the sympathetic system. The cranial subdivision controls such activities as constriction of the pupil, to protect the eye from excessive light, the regulation of the heart, to prevent overtaxing, and the digestive processes, including the secretion of saliva. The sacral section regulates chiefly the discharging activities of the lower abdomen—the bladder, colon, rectum, and the genitalia, activities which often occur involuntarily under stress of emotional excitement.

The two subdivisions of the parasympathetic system

bear a semi-independent relationship to each other. There is no connection, for instance, between the constriction of the pupil to excessive light and the evacuation of the bladder under pressure of distension. Most of the visceral organs are under the double control of the two subdivisions of the autonomic system. In the case of the heart, for example, the sympathetic function is to accelerate, the parasympathetic to restrain. There is, then, a reciprocal though opposed relationship between the two, so that whenever an emergency situation confronts the individual (animal or man), the activities related to digestion and sex are inhibited, and those having to do with defense and escape are facilitated. Energy, so to speak, is liberated and transferred from one set of organs to another, as occasion demands. One may readily understand, therefore, why one cannot feel angry and affectionate at the same instant; for anger is functionally related to the sympathetic system, and love is related to the parasympathetic system.

In a paragraph above, mention was made of the rôle of the adrenal glands in the coagulation of the blood. These glands serve other purposes in the emotional activity of the organism. Located by the kidneys, where they secrete *adrenin* directly into the blood stream, they counteract fatigue of the muscles, and stimulate the liver to secrete more sugar for the production of energy.

This relationship of the adrenal glands to emotion is well noted in an experiment by Pieron (21). Just prior to an operation two imbeciles showed a glycemic reaction of 1.31 and 1.01 grams of blood sugar per liter of cerebrospinal fluid. After the operation their reactions were 1.30 and 1.02 respectively. The patients had remained completely indifferent to the operation. Three soldiers, however, who submitted to the operation for military reasons, attempted to suppress and conceal their emotions, with the result that their blood-sugar increases

ranged from twenty-five to fifty per cent. Cannon has found an excess of sugar in the urine of athletes after a strenuous game.

Other glandular secretions related to emotional stress are those of the thyroid and the gonads or sex glands.

What recent experiments reveal.—Two outstanding lines of contribution to the physiological problem of emotion have been opened since the appearance of the James-Lange hypothesis. One of these lines emerges from the laboratory of Sherrington, in England; the other from the laboratory of Cannon, in America. The experiments conducted in these laboratories involved the surgical separation of the brains and visceral organs of dogs and cats. Thus, by severing the autonomic nervous system, the experimenters could test the validity of the James-Lange theory.

The results from both laboratories demonstrate that animals so operated upon continue to manifest signs of emotion when confronted by an exciting stimulus (5, 22).

Further experiments by Cannon and others, on human beings as well as upon animals, appear to cut the ground from the James-Lange theory. For instance, one notes that visceral changes of themselves provide no basis for differentiating the emotional states—specifically, fear from anger—that are quite distinguishable psychologically. Nor do these changes vary significantly from the emotional to the non-emotional. Such visceral activities as increased blood pressure, inhibition of digestion, profuse sweating, involuntary discharge occur in quite different emotional experiences. One may be tearful in joy as well as in sadness. And in states like fever, cold, asphyxia, as well as effects produced by injection of insulin, similar visceral agitation occurs.

Again, the visceral organs have been discovered to be relatively *insensitive* structures. Whatever changes occur

therein are registered upon the brain, not directly, but through their effects upon other organs. Hence, it would seem that James and Lange were in error in supposing the brain to receive sensory impulses directly from the commotion of the viscera. Besides, experimental evidence shows that visceral reactions are relatively too slow to be as quickly perceived as James implied.

Singularly enough, it is possible artificially to produce visceral disturbances through injection of adrenalin. Human subjects, thus experimented upon, report peculiar feelings which simulate the emotions of fear, anger, or sadness. Such emotions, because they lack a stimulus-object, are "cold." When, however, a "setting" is arranged prior to the injection, as of conversation about sick children or dead parents, the reaction takes on the character of a genuine emotion (6, 9).

Now, the critics of the Cannon-Sherrington conclusions maintain that experiments upon animals are not at all crucial as regards the James-Lange hypothesis. They contend that the experiments do not rule out the possibility of previously-established emotional connections in the brain. Consequently, when a dog or cat is excited after severance of brain from viscera, the emotional expressions occur simply through revival of the original connections (3). In order to settle this argument there is need for further experiments, particularly with animals which have been reared in complete freedom from emotional situations. But even so, one may still aver that "inborn" emotional reaction patterns would be elicited in any case (4).

Cannon's explanation.—In the light of extensive experimental evidence, Cannon has arrived at an explanation of emotion in terms of brain structure (7). To understand this explanation, one needs to refer again to the evolutionary development of the brain as indicated in Chapter Six. There we noted that the human brain

exhibits five stages of growth, the third of which is of particular interest for the present discussion. This stage marks the appearance of the *thalamus* as a development of the brain stem occurring at the reptilian level of animal evolution. The thalamus is thus seen to be biologically prior to the cerebral hemispheres—the organ of higher behavior.

Now Cannon's explanation is based upon the discovery that all the brain structure appearing after the third stage, that is, superimposed upon the thalamus, is not necessary for the induction of emotion. By removing from an animal all the "new brain" and certain parts of the "old brain," he found that the animal could still display the familiar signs of emotional disturbance. But when the thalamus was removed, no emotional reactions took place.

Further evidence, of an indirect sort, provides cumulative confirmation of the primary rôle of the thalamus in emotion. For instance, infants show fear and rage immediately after birth. At this period, obviously, they could not have *learned* to express emotion to this or to that. Cannon maintains, therefore, that these infant displays of emotion are possible as thalamic reactions which naturally have the right of way in absence of cerebral, that is, "acquired," control.

Again, adults and children, when under the influence of an anesthetic, in which cerebral centers are suppressed, will give vent to emotional displays of fear and rage. And it is well known that alcohol and other drugs effectively release thalamic reactions through inhibition of the higher processes.

And clinical evidence is available to the effect that patients, suffering a lesion of the corticothalamic tract, will yield to impulses of laughing and weeping without experiencing the appropriate emotions. In such cases, even taunts and insults produce no effect. Moreover,

these patients often exhibit emotional behavior that is quite contrary to their actual experience. One may report a feeling of grief and be laughing at the same instant.

All such evidence leads Cannon to the view that *the thalamus is the primary physiological basis of emotional life*. A quotation is in order.

> "If there is a double control of behavior, however, both the inner conflict with its keen emotional accompaniment and the later partial subsidence of feeling are readily explicable. The thalamic patterned processes are inherent in the nervous organization, they are like reflexes in being instantly ready to seize control of the motor responses, and when they do so they operate with great power. They can be controlled, however, by the processes in the cerebral cortex, by processes conditioned by all sorts of previous impressions. The cortex can also control all the peripheral machinery except the viscera. The inhibited processes in the thalamus cannot set the organism into action, except the parts not under voluntary control, but the turmoil can produce emotions in the usual manner, and possibly with greater violence because of the inhibition. And when the cortical check is released, suddenly the conflict is resolved. The two controls, formerly in opposition, are now coöperative. The thalamic neurones, so long as they continue energetically active, provide the condition for the emotion to persist, as James claims it does, *during* the manifestation. The new theory, therefore, not only avoids the difficulty of the James-Lange theory, but accounts satisfactorily for the poignancy of feeling in the period of paralyzed inaction" (8).

Summing up at this point the physiological explanations, we may note their contrasting features. On the one hand, the James-Lange hypothesis defines emotion

as the immediate awareness of organic changes which directly ensue upon perception of an exciting situation, so that without these changes no emotion could happen. On the other hand, the Cannon hypothesis denies that organic changes are essential to emotion for the experimental reasons that emotion does occur without these changes and that the changes can be produced with no accompanying emotion of any genuine sort. The one indispensable physiological condition for the generation of emotional behavior is the thalamic structure of the brain.

The clinical technique.—In marked contrast to the approaches surveyed above, the clinical approach originates not primarily from an interest in pure science but from the practical need for a method of resolving the difficulties engendered in human personality by emotional *conflicts.* The essential feature of this approach is the view that emotion expresses a "tension" which arises whenever behavior is blocked either by an obstacle or person or from a sense of incompatible trends of adjustment. Otherwise, if adjustment proceeds directly and smoothly, no tension arises, and hence no emotion occurs.

To illustrate this view of emotion, let one consider the familiar effect of announcing to a class of students that an examination will be given on the following day. Immediately a state of apprehension develops on the part of a number, a state which increases in intensity as the examination hour approaches, and which is often accompanied by a desire to escape the ordeal. Here the relatively smooth flow of behavior—as of reading or listening to lectures—is interrupted under a circumstance which engenders the tension of marked concern or, more strongly, the tension of panicky fear. In extreme cases the tension develops as hysteria.

McDougall presents a striking case (18). A theological student enlisted in the medical corps and was sent to

the scene of battle. Every time a shell exploded in his vicinity, the student was seized by an uncontrollable fear and by an impulse to escape the situation. Another person might have succeeded in checking both the fear and the impulse to escape and thus become adjusted to the situation, unusual as it was. This student, however, became more and more distressed by virtue of a keen sense of incompatibility between a conviction of duty and the impulse to run away. Had he yielded to the impulse, that particular tension would have subsided. So long as "conscience" held sway, however, the tension would continue.

Emotion, then, is here interpretable as an expression of conflict generated by incompatible impulses which, in turn, involve incompatible goals. In this clinical approach, one need not be directly concerned with the location of precise physiological factors, nor with the meticulous analyses of introspection, though both have their contributory values; rather is it concerned with the organism-as-a-whole, that is, with the individual person who suffers emotional conflicts in the everyday sequences of life adjustments.

This approach, enunciated in varying forms by authorities of widely differing psychological inclination, has attained striking formulation in the doctrines of Sigmund Freud. To Freud, then, one may turn first of all for elucidation of the clinical theory of emotion.

Freud's explanation.—As a practicing psychiatrist in Vienna, Freud encountered numerous cases of hysterical disorders which appeared to have no basic lesion of an organic sort but which did suggest basic emotional disturbance. Even before he established his clinic at Vienna, Freud had hit upon the idea that hysteria and kindred ailments were in reality the expression of ineffectual attempts on the part of the patients to resolve incompatible trends of behavior. In the light of this

idea he developed his technique of diagnosis and treatment, and eventually brought forth his interpretation of human nature, which he designated *psychoanalysis.*

In reality, then, psychoanalysis is both a therapy and a theory. As a therapy, it embodies a technique of diagnosis and cure for neurotic disorders. As a theory, it offers an explanation of human nature in terms of a "dynamic conception which reduces mental life to an interplay of reciprocally urging and checking forces" (13). For our purposes, we shall take account chiefly of the theory in the form of a brief outline of its leading concepts.

The libido.—A fundamental psychoanalytic concept is that of the *libido.* In a broad sense this concept simply denotes the *vital energy* of the organism. In a narrow sense it denotes the energy of the *sex life,* not alone for purposes of reproduction but for all expressions of *love,* whether for self, parents, friends, or country. Unfortunately, in the hands especially of popular writers, the broader meaning of libido has been quite overshadowed by a too-exclusive reference to sex in its more restricted biological sense.

According to Freud, the libido tends to concentrate in certain areas of the body, revealing its presence in the form of supersensitive, or, as he designates them, *erogenous* zones. The primary zones comprise the organs of *nutrition* (oral), *excretion* (anal), and *procreation* (genital). As erogenous zones, they are characteristic of the infant's body as well as of the adult's. Consequently, Freud attributes "sexuality" to the infant as well as to the adult; for these zones, when stimulated by stroking, provide for the infant a source of pleasure which the infant strives to retain. The common observation, for example, that an infant carries to its mouth everything that it can grasp, not to mention the obvious thumb, appears to support Freud's contention. From his view-

point, therefore, human behavior becomes molded very early in life on the basis of these "pleasure zones."

Indeed, to understand clearly the psychoanalytic interpretation of emotion, one must envisage human nature as a battleground whereon a perpetual struggle is being waged between the enticements of pleasure and the demands of "reality," the latter signifying those life adjustments (often painful) which the individual must make if he would attain social maturity.

In the first few years of life, designated the *id* stage of development, the infant's motive is wholly to seek and to retain the pleasant feelings derived from stimulation of the libidinous zones. But deprivation occurs from time to time, signalized by outbursts of crying and temper displays. The infant then comes gradually to realize the influence of reality in the form of painful adjustments. For deprivation is an aspect of training. The infant's thumb, now frequently immersed in a noxious substance, is no longer a source of oral pleasure. The excretory functions, as a form of pleasurable release, undergo regulation through the pain of corporal punishment. Even the process of weaning, as a libidinal check, is fraught with shock to the infant organism.

All such incidents in the life of the infant induce conflict and hence emotion. This period of life, consequently, becomes of crucial importance for the future adjustment of the individual. For, in the view of Freud, one develops into a neurotic or into a normal person by the manner in which these early conflicts are resolved.

Following upon the infantile (id) stage of growth is that of childhood. Freud calls this stage (ages five to twelve) the *ego* level of adjustment. It is the period of life characterized by conventionalized substitutions, whereby the libidinous impulses find expression in socially approved forms. However, the child does not easily and without considerable conflict adopt these substitutions.

A greater thrill comes from wading in a mud puddle than from studying arithmetic. A keener satisfaction is obtained from an "all-day sucker" than from a bath. For all that, one may observe how, through the social activities of the home, school, and playground, the pleasure impulses of the id find all sorts of vicarious expression. Thus, under the regulative, if often repressive, ideals of the social group does character mature.

The third, and final, stage of growth Freud calls the *super-ego* level of attainment. This stage begins with the onset of puberty. It represents the period of definite assimilation by the individual of those social ideals imposed upon him in the earlier stages, so that he views them not as arbitrary restrictions but as personally accepted principles. Accordingly, the super-ego may be understood to be the psychoanalytic equivalent of conscience. As such, it represents the cumulative effect of the restraints and the whippings undergone by the individual, as well as the more positive promptings of authoritative counsel. Thus, on the super-ego level, one can turn on oneself, as it were, and condemn as sinful and immoral one's own id impulses and ego lapses. And because one can so turn on oneself, the possibilities of conflict become multiplied and intensified.

With the onset of puberty, as is well known, there ensues a revival of interest in body pleasures, a revival accompanied by an acute sensitiveness to the presence of the opposite sex. It is the age of "primping," the age of self-consciousness and sex-consciousness. It is the age marked by tendencies to autoeroticism and other forms of sex perversion. For it is the age characterized by renewed sensitivity of the libidinous zones, particularly the genital. And by reason of conventions, this renewed sensitivity creates an inescapable problem of self-control, a problem fraught with more or less intense and intolerable conflict.

Thus Freud conceives the development of human personality. Through the stages of the id, the ego, and the super-ego, one's personality is fashioned in the fires of conflict. Impulse and repression, pleasure and reality, the individual and society—these are the opposing forces which create and feed the fires. But conflict, as a permanent condition, is intolerable to the organism. Ways, therefore, are sought for resolving the conflicts.

The unconscious.—Here comes into view another basic psychoanalytic concept. The unconscious represents the cumulative energy of all those impulses which, by intervention of parental and social restraints, are denied overt expression. It is a home, so to speak, for the repressed and forgotten. Nevertheless, they lose none of their dynamic quality by being repressed; on the contrary, they are more dynamic through being repressed. Ever and anon do they seek an outlet—through dreams, slips of the tongue, flashes of humor, and various automatic activities.

Dreams, especially, provide the clues to the unconscious. For dreams, in the view of psychoanalysis, bizarre and chaotic as they may be to the dreamer himself, never just happen "out of the blue." Every dream is motivated by some incident in the dreamer's life, and is fashioned by the repressions that have occurred during his life. In fact, the dream represents a graphic expression of unfulfilled wishes. All the impulses and desires which can gain no satisfaction of completion in waking life, because of repressive taboos, do achieve completion and satisfaction in substitute forms, as in dreams. In the latter, these forms comprise the imagery, so vividly recalled at the breakfast table, and they are symbols of wishes which, by reason of their subtly vicarious nature, require translation. But only the expert in psychoanalysis can undertake this translation; the dreamer him-

self cannot do so for the simple reason that his super-ego would flatly deny the hidden meaning of the symbols.

The interpretation of dreams is the central feature of the Freudian technique for unveiling the mysteries of neurotic behavior. For such behavior is motivated by conflicts which, though to all outward appearances they may have been resolved by stern repression, nevertheless persist in an intense form in the unconscious, and through dreams, particularly, betray their existence.

But aside from dreams, conflicts betray their presence in what are called "conversion symptoms." Hysterical fits, amnesias, paralyses, muscle spasms and contractures are some of the more spectacular manifestations. Headaches, insomnia, and worries that appear to have no cause are some of the more common forms. But whatever the particular manifestation, these symptoms indicate either a faulty attempt at resolving conflicts or a total inability to effect a salutary compromise between the "reciprocally urging and checking forces." Such a compromise, as will be seen in the following chapter, is primarily a matter of successful *sublimation* rather than blind repression.

Jung's explanation.—As a variant from the Freudian interpretation, Jung's viewpoint emphasizes a broader conception both of the libido and of the unconscious. For him, the libido loses its primary Freudian significance as sexual energy, and takes on a wider application than it does with Freud. Moreover, Jung expands the concept of the unconscious to include not only the sum of the repressions of one's personal life but also to include, in a sort of telescoped condensation, the whole experience of the race. Jung accordingly defines the unconscious in terms of a double contribution to behavior—the *collective unconscious and the personal unconscious* (16).

In many respects the hypothesis of Jung is similar to that of Freud. A fundamental difference may be noted,

however, in the relative rôles of sex repressions as contributory factors in conflict. For Freud, the sex factor is all-potent; for Jung, it is but one of many factors. One would therefore expect to find that Jung's method of interpreting dreams would not tend to emphasize sex to the exclusion of other "urges." Indeed, Jung sees in the dream a symbolic expression of some obstacle to successful adjustment, the nature of which may be discovered only through a knowledge of the dreamer's everyday problems.

Adler's explanation.—A further variant of the Freudian view is that of Adler. He conceives emotional conflict to be rooted in a *feeling of inferiority*. This feeling is an inevitable consequence of the fact that human nature is basically a striving for power, so that when one is thwarted, an acute conflict develops which threatens to disarrange one's original life pattern. Fundamentally, the thwarting is traceable to some constitutional or anatomical defect—an obtrusive birthmark, a club-foot, a weak heart, a diminutive physique, and the like. But whatever the defect, it forms the nucleus of the *inferiority complex* (1).

Conflict thus arises from the clash of the inherent striving for superiority and the restraining sense of deficiency. One may resolve the conflict, however, in one of three ways: *by a direct overcoming of the defect through special training,* as in the well-known case of Demosthenes, who became a renowned orator in spite of a lisp; *by a compensatory activity,* as in the reputed case of Byron, whose congenital lameness blocked numerous avenues of achievement and may have been the unapparent source of literary prowess; or *by flight into neurosis* whereby the individual capitalizes his deficiency as an escape from the responsibilities of life (1).

Thus, in the clinical approach to emotion, no matter what the particularity of emphasis, one observes the

central feature to be a conflict of motives, a conflict generated from the frustrations which a developing personality experiences as an inevitable aspect of his growth as a socialized being.

SUMMARY AND CRITICAL REVIEW

By passing in review these attempts to explain the nature of feeling and emotion, one may observe how each of them presents a distinctive conception and analysis of that nature.

First of all, the *introspective method* conceives the problem in terms of pure science, and thus lays emphasis upon rigid laboratory techniques. By these techniques, this method disclosed the facts that feelings were of two differentiable types—pleasantness and unpleasantness—and that these types were roughly localizable in the body as bright and dull pressures. This method of attacking the problem, however, has often been criticized as productive, in the main, of but sterile results, at least so far as a practical understanding of emotional behavior is concerned. In any event, the phenomena of feeling and emotion are altogether too elusive for this mode of approach. Psychologists have therefore turned to physiological methods of investigating emotion.

The James-Lange approach, while taking for granted the introspective facts, nevertheless set the program for the physiological attack. James and Lange did this, however, mainly from logical considerations, inasmuch as their emphasis upon visceral disturbance could very well have been made without ever looking inside a laboratory. For all that they performed a necessary psychological service in stimulating physiological experiment.

The Sherrington-Cannon experiments demonstrated that emotional behavior was possible without visceral disturbances, thereby casting doubt upon the James-Lange conclusions. Other experiments involving artifi-

cial induction of visceral disturbance revealed no accompanying emotion.

Cannon, therefore, offers an alternative theory of emotion, namely, that the thalamus is the primary and indispensable mechanism for the production of emotional reactions.

Finally, an altogether different theory of emotion appears, the central thesis of which is that emotion is a tension of the organism-as-a-whole, a tension induced by conflicting trends of behavior, evoked by incompatible goals. This conflict theory, in contrast with the introspectionist and physiological methods, lays primary emphasis upon the practical problem of personality integration, an emphasis, however, which should be seen as supplementary to the other methods.

It is in psychoanalysis that the conflict theory appears in graphic illumination. Here one observes feeling and emotion as the matrix in which personality itself is fashioned. From infancy to adulthood, life is envisaged as the libidinous assertiveness of the sensitive zones clashing with the mandates of society in the form of restrictions and regulations, and evoking thereby those conflicts the resolution of which makes or mars the whole individual pattern of life. On the one hand, resolution by blind repression creates a proliferous breeding ground (the unconscious) of pestiferous "complexes" which break forth as symbolic forms in dreams, hysteria, amnesia, and inexplicable anxieties. On the other hand, resolution by sublimation stabilizes the personality so that emotions appear as mere ripples on the surface of life, not as volcanic eruptions.

In critical estimate of the psychoanalytic contribution to the study of emotion, one is struck by its uniqueness of terminology. Nothing like it appears elsewhere in science. Indeed, the critics look upon this terminology as proof that psychoanalysis is literary, not scientific

psychology (19). The psychoanalysts maintain, on the contrary, that ordinary scientific terminology is quite inadequate to describe the facts revealed through clinical observation (2). The critics, again, decline to accept the conclusions of psychoanalysis as not scientifically, because not experimentally, validated. And to this Freud replies that by the same token one must deny that the conclusions of astronomy are scientifically valid (12).

But looked at from the standpoint of plausibility, psychoanalysis presents evidence which at least appears fascinatingly real. Its account of the developing personality through the stages of the id, ego, and super-ego strikes one as a veritable mirror of one's own self. And it is this aureole of plausibility, despite the impedimenta of its terminology, which has won for psychoanalysis a widely acknowledged place in the psychological, psychiatrical, and literary suns.

Still, there is the insistent question—what validity has clinical evidence? For psychoanalysts, the validity is attested by the cures. Accordingly, the basis upon which psychoanalysis is to be judged must be primarily a pragmatic one. If this is so, then the evidence can extend no farther than plausibility. For the same test may be applied to validate widely distinct, if not contradictory, explanations. When one considers, for example, the variegated claims of such therapeutic agencies as Couéism, Christian Science, prayers to the Virgin Mary and the saints, not to mention primitive magic and the more respectable methods of modern medicine, one is bound to recognize that such evidence is at least fundamentally different in kind from that of the experimental laboratory. For the latter provides opportunity for the control of conditions, for the elimination of irrelevant factors, and for the substantiation of factual evidence through repetition of experiment.

It is for such reasons just mentioned that Cannon's

demonstration of the thalamic basis of emotion carries weight. This weight, however, should not be overestimated. After all, the physiological mechanisms of emotional behavior do not completely account for that behavior. Cannon has proved that the thalamus is necessary to emotion; he has not thereby shown how emotions are differentiated from each other. Fear is not the same as love, nor are love and fear the same as rage. Here, then, is a further problem, but not one that is insoluble if one looks to the configurative character of emotional behavior.

Cannon himself, and others, have already thrown an indirect light upon this further problem by means of the experiment of adrenalin injection. This experiment, it will be recalled, demonstrated a sort of pseudo-emotion to which the descriptive term "cold" was given. Under the conditions of this injection the subjects reported feelings "as if" being afraid or angry or sad. But when emotion-provoking conversation preceded the injection, the subjects reported genuine emotion. Hence it appears that a real emotion requires for its production not only the neurovisceral mechanisms but also a meaningful situation.

Even the James-Lange theory provided for this meaningful situation, but did not clearly recognize the true significance of the neurovisceral conditions. And the conflict theory, too, provided for meaningful situations by its emphasis upon distracting goals and discordant motives.

To sum up, one may define emotional behavior as a reaction of the whole organism under conditions of the environment which engender tension and conflict. Whether tension shall arise or not, and whether the emotional expression shall be love, fear, rage, or sorrow, depend again upon how the organism itself perceives the situation. Certainly, as a total behavior pattern, the

characteristic features of emotion are its pervasive and possessive qualities, and its tendency towards precipitate climax.

QUESTIONS FOR DISCUSSION

1. How would you express your understanding of the introspective problem of feeling and emotion?
2. Give the gist of the James-Lange theory. Does it impress you as highly plausible when you reflect upon it?
3. Summarize the physiological conditions of emotion.
4. What precisely was the Sherrington-Cannon method of testing the validity of the James-Lange theory? Were the results obtained by this method entirely conclusive? Why, or why not?
5. Evaluate Cannon's evidence for his theory of emotion.
6. How, in brief, would you distinguish the clinical from the physiological approaches?
7. Give the essentials of the Freudian view of personality development.
8. What is your evaluation of the Freudian view?
9. What are the differentiable points in the theories of Freud, Jung, and Adler?
10. What do you understand sublimation to consist of? Illustrate.
11. How cogent would you say is Freud's reply to his critics.
12. Evaluate the evidence of the clinical approach.

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CHAPTER IX

EMOTIONAL BEHAVIOR—SECOND SECTION

Upon a background of acquaintance with the several explanations of emotional behavior, one is now prepared to consider further aspects of the problem of emotion. These aspects may well be indicated by such questions as the following: How do the particular patterns of emotional behavior develop? Why, for example, does a child fear to be left alone in the dark? What are the ways of judging and testing these patterns? How do these patterns expand into all sorts of attitudes and modes of adjustment in daily life? What are some of the consequences, social and personal, of these attitudes and adjustments? How may emotional behavior be controlled in the interests of social and personal welfare?

Such questions obviously suggest implications of immense practical importance. In the present chapter, accordingly, the answers which modern psychology is prepared to give will be presented in some detail.

HOW EMOTIONAL BEHAVIOR-PATTERNS ARE DEVELOPED

In the chapter immediately preceding, we discovered two important developmental factors—the rôle of the thalamus and environmental circumstance. Under experimental conditions these factors are somewhat differentiable from each other. But these factors revive the issue of heredity and environment, an issue accentuated by the discovery that infants display emotional activity soon after birth or before they have had opportunity to learn to be emotional. In the present connection the

issue pertains to the question as to whether or not one inherits emotions, and if so, what in particular. Should we say, for example, that one's fear of the dark is *inherited* or *acquired,* and should we say that fear of snakes is *instinctive?*

The question of inherited emotions.—As with many other problems of human nature, popular usage of biological and psychological terms has raised a "smoke-screen" of obscurity and confusion. One hears that So-and-so is a politician by instinct, that Johnny instinctively takes to music like a duck to water, that Bill goes fishing and hunting because of an instinct inherited from savage ancestors, or that women inherit a strong instinct of curiosity. In fact, so loosely is the term instinct used in everyday speech that a careful survey would reveal every conceivable pattern of behavior to be instinctive (3).

Professional writers on human behavior also typify this extraordinary confusion. McDougall maintains that instincts, which he groups as "major" and "minor," are the essential springs or motive powers of all thought and action" (23, 24). Thorndike offers a very long list of instincts covering almost every type of human response (31). Freud appears to avoid the enumeration of specific instincts but refers rather to such vague types as "id instincts," "ego instincts," and "death instincts" (9). Wheeler denies that there are any instincts at all, and maintains that heredity provides nothing but the structural mechanisms by which, in interaction with environmental agencies, behavior patterns are produced (36).

From this medley of contrary and contradictory usages and opinions, what is the student of psychology to conclude? Nothing, except to refer the entire problem of instinct back for experimental solution. Fortunately, significant attempts to apply experimental methods to this problem have been carried on in recent years.

The experimental production of emotions.—It is possible to "manufacture" emotions in the laboratory by what is called the technique of *conditioning.* It is really the technique of inducing a person to learn to be emotional towards certain objects, situations, or persons. Conditioning, in short, is habit-formation. But one should distinguish this sort of learning from that which was discussed in previous chapters by noting that conditioning is more of an involuntary process, while learning, in its usual meaning, is a voluntary, or at least a deliberate affair. To illustrate: One does not voluntarily develop the habit of reacting emotionally (fear) to the sight of blood; one does, however, voluntarily undertake to learn to typewrite.

Pavlov's experiments.—The original experiments on conditioning were performed with dogs. Pavlov, and other Russian physiologists, observing the common occur-

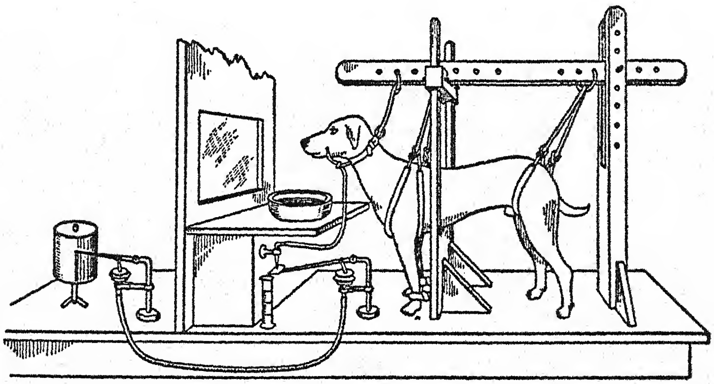


Fig. 36
[From Garrett (11)]

rence of "mouth-watering" at the sight of food, conceived the idea of causing the saliva to flow by means of substitute stimuli. His method may be very simply stated.

A test tube is attached to the salivary gland of a

hungry dog for the purpose of measuring the amount and rate of flow under different conditions of stimulation (Fig. 36). First, the normal flow is measured when food is presented to the dog but without permitting it to eat. Then, at successive presentations of food, simultaneously a bell is rung. After a number of such presentations, the bell is rung without the food, but the saliva flows just the same (11, 27).

Here, then is an instance of conditioning a "natural" (reflex) type of response to an artificial stimulus. Pavlov and others have varied the experiments so as to elicit the salivary response to numerous kinds of artificial stimuli. This sort of conditioning, however, is limited by the fact that, if "pushed too far," the dog will fail to respond. Yet, on the basis of such experiments, there has been formulated the *conditioned-reflex theory of behavior.*

Watson's experiments.—In America, Watson undertook to apply the above method to infant behavior. His experiments, conducted in a maternity hospital, had two objectives in view; first, to determine what "inborn" behavior patterns the infant has; second, to determine whether or not emotional patterns can be built into an infant by conditioning. By selecting for the experiments both new-born infants and other infants who had not been subjected to any training, he found it possible to rule out all effects which could presumably be attributed to learning.

Briefly stated, Watson's procedure was as follows. A lively black cat is brought into a room and allowed to walk around, to climb over, and to rub its body against an infant. The infant displays no sign of fear. Older infants actually extend their arms to grasp the cat. Again, a rabbit is presented to an infant without producing any signs of fear. White rats elicit no response at all, presumably because their almost neutral color lacks for an infant a stimulative quality. Airedale dogs cause

no excitement even when brought to a child in a darkened room. Indeed, no evidence at all appeared during the experiments that darkness, as such, is a natural excitant of fear (14, 15, 33).

However, objects and situations were discovered which do produce emotional responses. For example, a sudden loud noise, such as striking a steel bar with a hammer, brings forth a series of pronounced emotional activities on the part of an infant—sudden start, catching of breath, perspiration, and accelerated pulse. Again, these responses occur when support is suddenly withdrawn from the baby, as in allowing it to drop to the bed from a height of several inches. Moreover, behavior typical of rage appears whenever the baby's movements are hampered, as in the case of forcibly holding the arms and legs. And again, responses characteristic of love are elicited by stroking, patting, and gently rocking. Since, in all these cases, no training has been imposed, Watson concludes that these stimuli naturally induce emotional responses such as the above and that these stimuli are the original bases of all emotional behavior.

In view of the results thus far obtained, Watson and his co-workers undertook to create emotional patterns by the process of conditioning. To illustrate: A white rat is brought to a child who, on ordinary occasions, would reach for it without the slightest trace of fear. This time, when the child reaches for the rat, the experimenter makes a sudden noise by striking a steel bar directly behind the child's head. The child is startled. Eventually, after eight successive experiments of this sort, the child exhibits fear whenever the rat is brought in, even though no noise is made. Noise stimuli may be attached to any object or person or situation and fear reactions elicited.

It is also possible to uncondition an emotional response previously established. A typical procedure may be cited. A child is selected for experiment who, by some means

or other, has developed a strong fear of rabbits. At lunch time a rabbit is brought in a cage and placed just inside the door. The experimenter moves the rabbit day by day in easy stages towards the child, taking care not to distract the child from his or her food, with the result that the child gets so accustomed to the rabbit's presence that eventually he or she will actually play with it with one hand while eating with the other.

How the experiments typify life situations.—Numerous experiments of a similar sort in various nurseries offer plausible evidence that one's emotional behavior patterns are almost wholly the product of conditioning, that is, learning. Thus, when a woman shrieks at sight of a mouse, or goes into mild hysterics upon seeing a bug on her arm or neck; when a child screams with terror on being forced into a dark room; when a man faints, or experiences a "sinking of the stomach," on viewing an operation, one may interpret such behaviors as instances of conditioning.

More striking cases are noted in *phobias* or morbid fears. An oft-cited one is that of the soldier who suffered so intensely from *claustrophobia*—morbid fear of being in an enclosed space—that he became panic-stricken whenever he had to enter a dug-out. Despite all his efforts at self-control and analysis, he could give no reason for his fear. By psychological analysis, however, he was able to recall an incident of childhood in which he had been terribly frightened by a growling dog in a dark, narrow alley (25).

Another case is that of a phobia of splashing water. The victim of this fear was a young lady who, as a child of seven, had been taken by an aunt for a stroll in the woods; but against the aunt's remonstrance she had run off alone. Later in the day, the aunt found her in a terrified state, wedged between rocks, and with water splashing all about her. On being rescued she exacted a

promise from the aunt not to inform her mother of the incident. Apparently the incident itself passed from the child's recollection but subsequently appeared as a phobia of splashing water. And not until thirteen years had elapsed did she overcome the fear when, on a revisit to the family, the aunt recalled the incident (2).

Similar cases may be cited in profusion to show the effects of early conditioning. Often, as in the above cases, a single incident of a harrowing nature is sufficient to establish an emotional reaction to a particular situation. But one need not remain a victim of some obsessive fear. From the case cited above, one obtains a suggestion for overcoming and eliminating such fears by frankly recognizing their origin as conditioned affairs, and by undertaking, where necessary, a process of reconditioning.

A further suggestion emerges from the experiments, namely, that early conditioning is responsible for all the antipathies, prejudices, and jealousies, as well as the sentiments of reverence and affection towards many objects and situations which adult life expresses.

What the experiments offer upon the question of inheritance.—On the question of inheritance of behavior patterns (instincts), the experimental evidence, as illustrated above, may not offer a complete answer. Watson's results do appear to indicate that three emotional patterns—fear, love, rage—are inherited; that is, they are unlearned responses. Whether or not they are correct designations for infant behavior is a matter of dispute. Some psychologists contend that so to classify infant behavior is an arbitrary procedure (17). Watson himself refers to these responses not as "instincts" but as "reflexes," of which, from experimental testing of infants, he claims to have discovered at least seventeen. Some of these reflexes, in addition to those mentioned above, are hiccoughing, crying, feeding, smiling, blinking, and

so on. And upon these as basic, all other patterns of behavior are formed by means of conditioning (34).

Frankly, one may accept the experimental data respecting these reflexes without admitting the behavioristic (Watsonian) interpretation to the effect that *all* behavior is constituted of reflexes in the sense of additive connections. We have already seen the inadequacy of such an interpretation. Fear of the dark, for example, is not explained at all by calling it a conditioned reflex, or even a pattern of reflexes, in any mechanistic sense. For the conditioning process involves more than a piecemeal aggregation of reflexes; it involves the individual's total impression of the environmental situation, an impression which cannot be broken up into bits, as reflexes, and still be meaningful.

Furthermore, we have seen how futile is the attempt to separate heredity and environment. One does indeed begin life with an inherited equipment in the form of a neuromuscular-organic structure. *One's behavior, however, is a product of the interaction of this structure with environmental conditions and is therefore both inherited and acquired.* The concept of instinct thus becomes useless, particularly for practical purposes. One may just as well conclude that fear of the dark is an effect of conditioning as to conclude that it is instinctive. In fact, conditioning is the preferable alternative when one considers the implications of fatalism in the instinct theory. For if, in respect to behavior, the "leopard cannot change his spots," what is the use of inviting the "leopard" to the disarmament conference? And why have a disarmament conference? But such questions of social import must be considered later.

EXPERIMENTS IN JUDGING EMOTIONAL EXPRESSIONS

In the course of individual growth, one begins quite early to identify and to respond to the various indications

of emotional behavior on the part of one's fellows. These indications embody facial expressions, vocal sounds, body postures and movements. To read these signs accurately is obviously to aid one in making adequate adjustments in everyday social contacts. Many of the signs, it is true, overlap differing emotional patterns. One may blush, tremble, and perspire in both anger and fear. One's eyes may glisten in anger, fear, and love. Yet to the keen observer there are differences of a very subtle kind which he sees as tell-tale indices of the real emotion. The voice may express affection while the narrowed eyes and the closed hands denote contempt. One may even admit with Shakespeare that "scorn and derision never come in tears," yet so great is the human capacity to simulate contrary moods and expressions that without this capacity no drama could be effectively portrayed.

To test the accuracy of individual ability to judge emotional expressions, psychologists have experimented with a number of methods, of which two may be cited as typical.

The photograph.—A series of photographs (posed for by actors) is presented to a number of individuals for identification of mood, feeling, or emotion. Results invariably show that ability to judge a photographic expression depends upon the intensity of the feeling portrayed as expressed in extensity of facial change. Laughter will be judged correctly one hundred per cent of the time. Horror will be identified by about ninety per cent of the cases. Disgust runs a close third. Anger and fear are not as easily detected as the first three. In general, the percentage of correct identifications is greatest for the so-called "coarser" emotions and least for the more subtle moods and feelings such as reverence, sympathy, and timidity.

Part of the difficulty encountered in an experiment of this sort consists of finding adequate designations for the

photographs. The experimenter may give credit, or fail to give credit, for an identification on the basis of an arbitrary decision as to whether or not the particular judge's designation fits the expression intended. In fact, when a 'scrambled' list of terms is given to each judge before identifications are made, the percentage of correct statements becomes very high (1, 7). And part of the difficulty may also be attributed to the fact that a photograph is, after all, a poor method of suggesting emotional behavior.

Vocal inflection.—Here one may use phonograph records or the "live" voice. The latter is obviously preferable, inasmuch as the phonograph presents a somewhat artificial situation and may, besides, involve the distraction of a scratchy needle.

In the experiment to be cited, a vocal artist, hidden from view, sings a given note at a constant intensity for a duration of one and one-half seconds, five consecutive times at intervals of one second. The observers in this experiment were not informed beforehand as to the emotions to be portrayed, though the emotions intended were *surprise, anger-hate, fear-pain,* and *sorrow.* After each fifth repetition, the observers—thirty graduate students in psychology—were to note on paper the emotion they believed the tone to express.

Two series of experiments were conducted, using a different tone for each series: (*a*) the fundamental pitch E, (*b*) the fundamental pitch A. Table XVI presents the summarized results (29).

From the table it will be noted that sorrow is the most easily detected emotion, and surprise, the least. In the E series a total of eighteen different emotions was reported, and in the A series a total of fourteen; yet in each series only four emotions were intended by the singer. Apparently, as far as this experiment is con-

TABLE XVI.—Proportion of Correct Judgments of the Emotional Meaning of Two Vocalized Pitches

Emotion	E series		A series	
	Correct reports	Total reports	Correct reports	Total reports
Sorrow	18	22	22	28
Anger-hate	15	18	16	18
Fear-pain	10	20	7	17
Surprise	3	21	0	21

cerned, poignancy of emotional portrayal is not very likely to be missed by hearers.

Incidental to a discussion of vocal inflection as a means of conveying mood and feeling, one may cite the graphic recording of the speech of Shylock (*Merchant of Venice*)

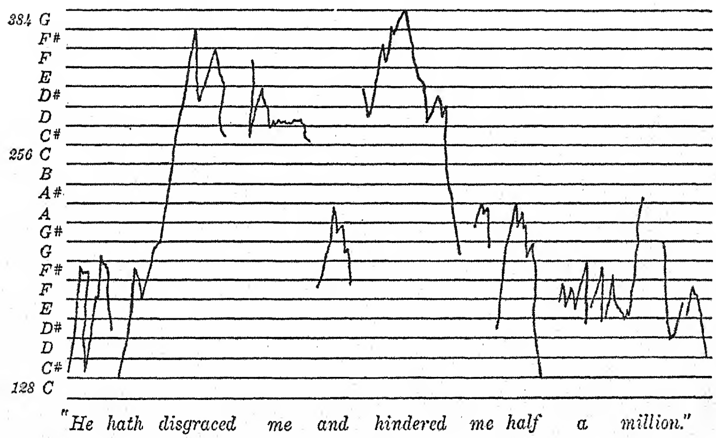


FIG. 37
E. H. Sothern, Victor Record No. 74673. [After Merry (26)]

by E. H. Sothern, the notable Shakespearean actor. Figure 37 shows the wide range of pitch employed in the utterance of a single sentence. For the word "disgraced" alone the inflection extends more than one octave. Such a variety of inflection palpably endows

any vocal portrayal with such emotional vitality as to elicit decided and unambiguous empathic reverberations in the listeners.

WAYS OF TESTING EMOTIONAL BEHAVIOR

Ways of testing emotions have mainly developed under the impetus of a practical need for a reliable technique of discovering emotional patterns not ordinarily observable. In the first place, a person may be suffering from some phobia or other "complex," the roots of which, quite unknown to him, lie in some forgotten incident of his past life. In the second place, an individual may be attempting to conceal or inhibit all emotional display for the sake of escaping certain consequences of detection. In the third place, one who frankly knows of his own emotional maladjustments may be in need of such information as a valid test might reveal.

The free-association test.—In standardized form, this test consists of a list of 100 common words, like *money, tree, grass, worry, door,* to each of which the subject is required to respond immediately with the *very first* word or idea which comes to mind when the list (stimulus) word is uttered by the experimenter. The experimenter pronounces clearly each word in turn, noting down the subject's *response word* and the *time* in seconds and fractions of a second taken by the subject for each response (16).

This test may be used to reveal some "complex" that is unwittingly disturbing the subject or to detect some concealed "guilt." In either case, results are indicated in two ways: by delayed reaction time, and by irrelevant or outlandish responses. If, on the one hand, the time for a given word exceeds two seconds, that particular word is "critical." If, on the other hand, the response is quite unusual—as determined by frequency tables (28)—that particular word is "critical" also. Critical words may be

used for further testing (or questioning) and their diagnostic implications determined.

During the test, a number of suggestive signs in the form of the subject's attitudes may also be noted by the experimenter or other keen observer. Some of these signs are as follows: (*a*) attempts to change the response, (*b*) fidgeting, (*c*) exclamations not meant as responses, (*d*) laughing or giggling, (*e*) failure to understand a given stimulus word, (*f*) repetition of a stimulus word, (*g*) asking questions about a stimulus word or response. Such signs may be written down by the experimenter in the form of a code but in a manner not to arouse the suspicions of the subject (35).

The diagnostic possibilities of this test appear quite fruitful. For resistances, which tend automatically to arise whenever a "sore spot" is piqued, express themselves in some manner—delayed reaction or otherwise. Hence, a series of associative links may be reconstructed and the "complex" disclosed and dissipated, or the felonious responsibility detected (21). Of course, the test presumes, for its successful application, the full coöperation of the subject being tested. A sophisticated individual may give delayed or outlandish responses to every stimulus word, in which event the test results are useless.

Cardiorespiratory tests.—These tests are based upon the principle that emotional disturbance involves measurable physiological changes as of blood pressure and breathing. The emotional effects may be concealed to all outward appearances, as in the case of the notorious "poker face," though not in respect to internal changes. A person accused or suspected of some misdemeanor or felony will ordinarily protect himself under questioning in order not to reveal the slightest tell-tale sign. But this very process of self-protection generates certain physiological tensions, and these become clues through instrumental detection.

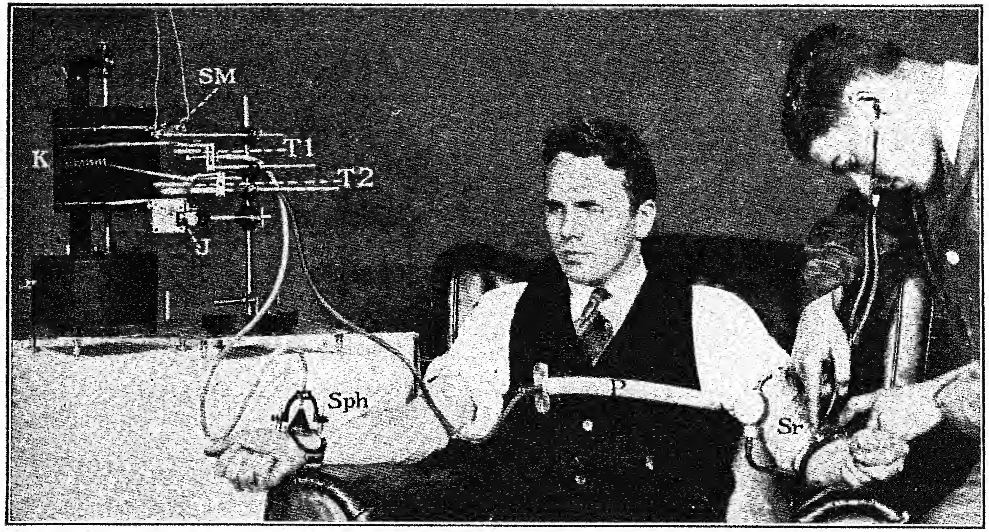


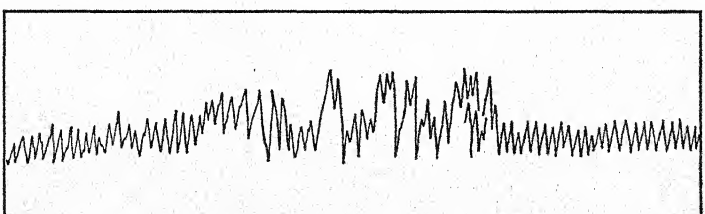
FIG. 38

The Pneumograph, Sphygmograph, and Sphygmomanometer, with Recording Devices.

The model of *pneumograph* here shown (Sumner), consists of a coiled spring *P* in a sealed rubber tube strapped snugly about the chest. Movements of inspiration and expiration stretch and relax the tube, drawing or driving the air in the small tube that connects with a recording tambour. The recording *tambour, T2* is a metal chamber covered with a rubber diaphragm, across which lies a free-moving pointer. Air on entering the chamber pushes the diaphragm and pointer upward and on leaving draws them downward (inscribing the third line). The model of *sphygmograph* shown (Mackenzie) is a cone-shaped tambour, *Sph,* the rubber diaphragm of which is fitted closely over an artery, so that beats there are pneumatically conveyed through a tube to a second recording tambour *T1* (inscribing the second line). The pointers of the recording tambours bear against smoked paper mounted upon the revolving drum of a *kymograph K,* operated by clock work. Simultaneous tracings are made by a *signal marker SM,* operating electrically to indicate points when a stimulus is given (top line), and by a *time marker* (Jacquet model shown) *J,* indicating seconds (bottom line). The model of *sphygmomanometer* shown (Tycos) *Sr,* is a silk-covered rubber bag wrapped about the upper arm and inflated by a bulb (held in examiner's left hand). The air pressure is registered on a dial slung in front and connected to the bag by a tube. [From Dashiell (37).]

A method of recording blood-pressure changes is to affix to the arm of a subject an instrument called a *sphygmomanometer* (*sphygmo,* pulse; *manometer,* pressure measure), an instrument familiarly seen in physicians' offices. In the case of a suspect, the record of normal pressure is obtained; that is, the pressure indicated before any questions or other implicating situations are presented. Then a number of questions of an indifferent sort are put to the subject, who responds with a simple "yes" or "no." After a short interval, questions pertaining to the alleged offense will be asked and the changes, if any, of blood pressure noted. In addition to questions, objects or persons connected with the circumstance of the offense may be employed.

The method of recording respiratory changes makes use of an instrument called a *pneumograph.* This is placed around the chest of a suspect and to it are attached devices connecting with a revolving smoked drum for recording the changes in breathing. A procedure may then be followed similar to the one described above. Figure 38 illustrates the procedure for recording both blood pressure and breathing.



Deception *After confession*

FIG. 39
[From Larson (19)]

Numerous investigators have carried on research with these methods, partly for the theoretical purpose of defining a constant relationship between emotional tension

and measurable physiological changes, and partly for the practical purpose of detecting perjury and dissembling in cases of crime. In the case of the latter, investigators report, on the basis of subsequent confessions and convictions, a reliability of instrumental lie-detection from fifty to one hundred per cent (18, 19, 20, 22). Figure 39 illustrates the trend of the curve of a typical case.

Table XVII shows typical inspiration-expiration ratios in differing psychological states.

TABLE XVII.—Inspiration-Expiration Ratios
[From Feleky (8)]

Normal breathing	.805
Laughter	.30
Hatred	.515
Disgust	1.08
Pleasure	1.11
Pain	1.54
Anger	1.48
Wonder	2.49
Fear	2.66

Physiological tests, as illustrated above, are frequently challenged as to dependency of results in view of the likelihood that an innocent person would, under the very conditions of arrest or suspicion, exhibit pronounced emotional changes. The investigators maintain, however, that the "curve" of an innocent person will vary within quite narrow limits from normal while that of a guilty person changes markedly as the critical questions appear. On telling the truth, one tends to relax; on committing falsehoods, one involuntarily tenses. Even "confidence men," who are proverbially adept in deceiving people without "batting an eye," reveal tensions measurable by the instruments (20).

Nevertheless, so long as there is a margin of error in the use of these tests, they cannot serve as absolute evidence in a criminal court. Until refined to the degree where success is obtained one hundred per cent of the

time over many thousands of cases, they can offer no more than "leads" to criminal attorneys and to the police in the solution of a crime. And as "leads" they have already demonstrated their value in provoking confessions.

Psychological inventories.—Under this heading, tests are included which aim to elicit from a given individual his feelings and moods by means of questions and statements descriptively indicative of various situations encountered in daily life.

The *Pressey X-O Scale* contains four series of tests designed to measure individual emotionality by requiring the subject simply to cross out all words which arouse in him feelings of disgust and unpleasantness. Typical words are *flirting, worry, money, spitting, sin,* and so forth. By totaling the words crossed out and finding the corresponding norms, one obtains an emotionality rating.

The *University of Chicago Personality Schedule* (Thurstone) consists of 223 items pertaining to emotional stability, examples of which are as follows: "Do you get stage fright?" "Are your feelings easily hurt?" "Do you worry too long over humiliating experiences?" "Can you stand the sight of blood?" "Does criticism hurt you badly?" From the score obtained, one may be classified in one of five "degrees" of stability, ranging from "Extremely well adjusted" to "Should have psychiatric advice."

Other inventories of a type similar to the above are serviceable, namely, the *Bell, Bernreuter,* and *Minnesota* scales, the scores of which are identifiable in terms of percentiles.

EMOTIONALIZED ATTITUDES AND ADJUSTMENTS

In the opening paragraphs of the preceding chapter, one was reminded how ubiquitous is the sway of feeling and emotion in the affairs of life. So ubiquitous is this

sway, indeed, that if one should disregard it, even on occasion, one would assuredly meet with social discomfiture. In none other than the emotional aspect of life is the reflection so allusive as that "no man liveth to himself." For we are highly sensitized creatures. We respond so readily to the attitudes of approval and disapproval of our fellows that at one time we may rise to heights of ecstasy, at another time sink to depths of despair. So much of life's success is staked on feeling that one understands quickly why a diplomat is a paragon of suave expression, why social amenities demand a profusion of "white lies," and why personal adjustments necessitate the subjugation of passion.

That feeling and emotion largely exemplify a primitive level of adjustment is an observation banal enough. To understand this level in terms of the physiological dominance of the thalamus over the cerebrum, however, is to achieve a measure of scientific insight which provides a real fulcrum of control. That is to say, one can envisage the problem of emotional behavior as one primarily of cerebral conditioning whereby the thalamic functions become subordinated to rational control. This conditioning, as has been emphasized often enough, involves the developing appreciation by the individual of his own goals as well as those of society, and the methods adopted for attaining those goals. And this developing appreciation is obviously no mechanistic bit-by-bit procedure; rather is it a discriminative process of assessing oneself in the very milieu of social living. Some individuals assess themselves quite faultily, some, quite effectively; but faultily or effectively, the assessments reflect emotionalized attitudes, and these, in turn, the character of adjustments. What these attitudes and adjustments are may now be considered.

Rationalization.—By rationalization is meant the *self-defensive* type of attitude exemplified whenever one feels

constrained to justify one's opinions and acts for the sake of maintaining one's self-esteem. One feels thus constrained on occasions of an embarrassing social blunder. Among oriental peoples it is known as "saving one's face," a useful psychological procedure for extricating oneself from a predicament. It is a familiar procedure in diplomatic circles when a nation's "honor" is at issue. Essentially, therefore, it is motivated by pride and fear as forms of emotionalized attitude.

One may consider, in illustration, the case of the mother who declines to permit a school psychologist to test the intelligence of her child. Her very declination implies a fear respecting the results of such a test as somehow involving a challenge to her own "integrity" in the form of an imputation of hereditary "taint." And this fear, coupled with an anticipatory sense of social disfavor, is too oppressive to contemplate. However, it would never do to admit this fear, even to herself; hence she conjures up as a reason for her refusal: "I just know the tests are silly and worthless, and so it is no use to give them."

When the defense of feeling takes the form of referring the blame for one's delinquencies or deficiencies upon another person or upon some set of circumstances, it is called *projection.* A sample of this sort of "defense mechanism" is provided by the following incident.

At a recent championship chess tournament the leading contestant, a former world champion, went down to defeat. But did he regard the defeat as an indication of inferiority on his part? By no means. The reasons he proffered for the misadventure were that the room was too stuffy, the playing table was at the wrong height, the illumination was bad, and there were too many persons and other distracting features for one to deal adequately with the chess problems. That this is a case of pure pro-

jection is readily seen on considering the fact that the same conditions applied to the one who won.

Projection is thus recognized as the "gentle art of the alibi." The quality and variety of illustrations which one may observe on golf courses, in athletic events, examinations, and social situations pass enumeration.

Projection sometimes takes the form of *self-pity*. As such, it is found chiefly among children as a symptom of a crushing feeling of inferiority. The child who sulks when thwarted, who avoids competitive games for fear of suffering defeat and taunts, or who is sensitive to his deficiency to an acute degree, is the child that is very likely to brood over his wounded feelings and, as he grows older, to seek refuge in the contemplation that the world is a cruel place, and that he is the victim of adverse circumstances. He may even tend to consider himself too good for the people or circumstances about him. Among adults, self-pity tends to express itself in chronic pessimism and fault-finding.

Another familiar form of rationalization is known as the "sour-grapes" attitude. It is quickly recognized in a situation where one has been deprived of a coveted honor, the presidency of some organization, let us say, either through insufficient votes or by failure of nomination. In such an event, one tends to "charm" one's feelings by a denial that the honor is worth having, by assuming an air of nonchalance, or by claiming that one is really too busy with other, more important matters. The variations of this theme are verily prodigious.

The converse of this attitude may be detected in cases where a person flatters himself with the idea that the failure or defeat was just what he wanted. For example, Arthur Doembraun, on receiving a failure in a course which he needed sorely to pass, offsets his chagrin by assuming the attitude that he really wanted to have his academic record decorated with an F. For an F is a

mark of distinction; it sets one apart from the "greasy grinds"!

Compensation.—Many persons attempt to maintain their status, psychologically speaking, by recourse to compensation; that is, to activities and interests as substitutive for those unattainable. Back of all compensation is a feeling of inferiority. We have already noted Adler's interpretation of human nature as a striving for power, and how an inferiority complex is generated as a result of frustration. While Adler tends to regard inferiority as due to an organ deficiency, one may recognize that the feeling of inferiority may arise out of imaginary situations, too.

Inferiority is generated in contrasting oneself unfavorably with others. A pigmy might develop this complex if compelled to associate with people of normal height; though among his own kind he might be highly esteemed. Likewise an individual of normal intelligence (I.Q. 100) may feel quite comfortable with others of his own mental level, but decidedly uncomfortable with those who rank notably above him. Wherefore, to understand the genesis of inferiority and the character of the compensatory effort, one must give full consideration to the social circumstances of the particular case.

Primarily, compensation develops as resistance to fear of failure. It is true that this fear is often a product of the awareness of a physical defect. The unusually short person is easily overlooked by, and in many ways is unable to compete with his fellows of normal and superior height. Frequently, therefore, the short person is found to be pompous in manner, a "loud" dresser, a loud talker, or to ride in a flashy car. He thus achieves a sense of power and avoids being "swamped" by his taller fellows. Again, a person with a very homely face or figure will strive to offset a fear of failure, say, in securing a marriage partner, by cultivating a sweet and other-

wise attractive disposition. And the student who is unable to reach a moderately high level of scholastic attainment will endeavor to excel in sports or as a "social light."

Gossipiness is often a compensatory expression of social inadequacy. To be in a position to inform one's neighbors of a "juicy" piece of scandal pertaining to an intellectual or social superior puts one for the moment, at least, in an expansive mood. To laugh at another's misfortune, to feel smug over the undoing of a rival, or to get exhilaration out of a superior's defeat are indices of one's own attempts to triumph over one's feelings of inferiority.

Moreover, this tendency to compensate for failure may manifest itself as "overcompensation." Psychoanalysts designate this tendency "reaction-formation" (13). It is essentially a protective device. One of its aspects is the suppressing of one's own feelings of inadequacy by exaggerating the faults of others. Thus the carping critic diverts attention. Thus, in numerous cases of professional reforming, does the individual conceal his weaknesses. To rave against sin and vice, to condemn women's apparel, or lack of apparel, to crusade against the "pleasures" of the world, to see "red" in any difference of economic or political opinion from one's own—all such attitudes serve to intensify one's own "ego." Otherwise, the critic and the reformer might be merely one of the great mass of unhonored and unsung inhabitants of the land. And to be merely one of these would create too distressing a sense of personal inadequacy. But no such sense of inadequacy can arise in consciousness so long as one can mount a platform and expand on the plaudits of one's fellows.

Another aspect of overcompensation may be recognized in efforts of excessive apology or confession. Here, protection consists of the assuming a penitential attitude

whereby one's feelings of guilt may be assuaged. Individuals who exemplify this attitude are in reality the victims of a supersensitivity to certain conventions of morals and of etiquette. Hence they frequently suffer from a tortured conscience which, by some sort of penance, they hope to palliate.

Compensation, again, frequently takes the form of *parental projection of ambition.* Such instances as these arise out of feelings of disappointment which the parent seeks to mitigate by demanding that his offspring fulfill by substitution the cherished ambition. Thus, without regard to aptitude, interest, or other qualification, a parent may insist that his son become a doctor, for example, or that the daughter achieve a "marriage of distinction." Thus, also, may the frustrated divorcée seek emotional satisfaction by coddling and "protecting" her offspring to the latter's psychological detriment.

Some psychologists are inclined to regard lodge ceremonials as instances of compensation. Indeed, at first sight, it does appear plausible that a man or woman who lives for the most part a rather drab sort of existence would get an emotional "kick" out of the opportunity to decorate himself or herself in scintillating regalia and to be addressed as the "Supreme Exalted Ruler of the Mystic Sanctum" when in private life he may be a menial office clerk and she a humble housewife.

Many, indeed, are the compensatory ways by which individuals protect themselves from the morale-destroying feeling of inferiority. But one must recognize in all such interpretations as the foregoing the need for extreme caution. Granted these modes of protecting, mollifying, and elevating one's feelings, one cannot be too cautious in diagnosing a particular case. Certainly, one should never be misled by surface manifestations. A student who participates strenuously in athletic contests may *not* be compensating for intellectual inferiority. A person's

insistence on "clean" movies may *not* be concealing an illicit love affair. Nor may an absorbing interest in lodge ceremonials be a compensatory outlet for a sense of social inefficiency. Only by a thoroughgoing analysis of an individual's background, temperament, and goals can it be determined that *this* or *that* activity is compensatory.

Besides, rationalization and compensation fulfill necessary demands of human nature. Despite the likely distortion of personality perspective by emotionalized attitudes, these attitudes are fundamental to human nature as only deep-seated habits can be fundamental, a circumstance which everyone who proposes to change human nature must face. Granted the proposition that they are results of conditioning, they are not, for all that, as easily disposed of as last year's overcoat. One may rightly detest deception, but if one fails to inform one's hostess that her party was very enjoyable—one's feelings to the contrary—one gets no more invitations.

Life is such that one simply must save one's face. No ordinary human being can tolerate continual thwartings, defeats, and persistent feelings of "being in the wrong." That way lies madness and suicide. Rationalization, perverse as it often is, fulfills the vital human need for morale. For embarrassment is painful; admission of fear is distressing; a guilty conscience is torturing; therefore rationalize.

Likewise compensation: it, too, makes for morale. The clubfoot *may* have directed Byron into poetry. If so, the world has gained. And if achievements in scholarship, in literature, in the fine arts, and in scientific inventiveness emanate from inferiority complexes, as the pearl emanates from a condition of irritation, then indeed is victory a measure of defeat; and the inferiority complex becomes transmuted as the "golden complex" (5).

Regression.—By regression one adjusts oneself upon a lower and simpler level. It is a reversion to childish

modes of adaptability. One finds ready illustrations of regression (of a mild sort) in ordinary nostalgia, or homesickness. The boy or girl who leaves the parental shelter for the first time in going away to college experiences a regressive impulse when he or she breaks into a fit of weeping and remains inconsolable until "mama" or "papa" arrives. Normally, the condition wears off as adjustment to the new situation is effected, though in some cases the result is a complete abandonment of a college career. In another mild form, regression appears as sentimental wishes for a return to the "days of long ago," particularly the security of childhood.

A more significant instance of regression is found in hysteria. Here the individual, when squarely confronted by a difficulty, frustration, or a threatened load of responsibility, will seek to escape through the equivalent childish tactics of the tantrum. For the individual reacts to the difficulty as an unbearable unpleasantness which he will evade at any cost, doubtless as a result of misguided conditioning in childhood where every effort was made to provide him a "primrose path and bed of roses." Assuredly, a policy of shielding a child from all situations of unpleasantness and pain furnishes no preparation for the conflicts of life.

The regressive motive is frequently found in religion. Here the motive of security is expressed in emphatic declarations of the need for cultivating childlike attitudes of faith and hope. The hymns of the church embody this motive to a considerable degree, and many of the prayers affirm the dependent relationship of devotee to Deity as of child to father. Freud interprets the religious attitude as essentially regressive in so far as it exemplifies a continuation of childish dependence and serves as an escape from the harsh responsibilities of real life (10). For when one is urged to cast one's burdens on the Lord, to repose peacefully, "safe in the arms of Jesus," or to

look to heaven as a place where all the sorrows of this life will be compensated by the joys of eternal felicity, where one may wear a crown of gold, walk on golden streets, and bask in the sunshine of a never-ending glory, one is persuaded virtually to abandon the struggle for self-dependence and to revert to childish attitudes.

Freud's view of religion is disputable, of course, on the ground that it portrays but one, and that not an essential, feature of religion. Certainly, a childish attitude toward religion is no valid index of the nature of religion itself. But Freud's view is sound in so far as it pertains to a primary emphasis in religion of emotionalized attitudes at the expense of intellectual progress.

SOCIAL EFFECTS OF EMOTIONALIZED BEHAVIOR

It is a commonplace observation that emotional behavior is contagious. One has only to shout "Fire!" inside a crowded theater to demonstrate the celerity of this contagiousness and its precipitate effect upon behavior; so much so, indeed, that the intended purpose of escape becomes frustrated by the consequent jamming of exits. Here, then, is a plan instance of thalamic control of behavior, a control extremely difficult to checkmate through intervention of the cerebrum. In other words, the very contagiousness of emotion is an evidence of its prepotency in human conduct, a prepotency derived from the biological priority of the thalamus in brain development.

In considering the social effects of emotion, therefore, it is of great importance to recognize this prepotency as a resistance or obstacle to the more deliberate and monitory processes of intellect. For the latter not only appear very late in the scale of biological evolution; they also develop very slowly. Conversely, emotional behavior appears earlier, is more primitive, and tends to take the right of way in conduct.

One may now understand why a theater crowd will always stampede at the cry of "Fire!" unless each individual in that crowd has learned, thoroughly learned, to control his thalamic impulse in such an emergency and calmly to estimate the most effective means of escape. So to control and so to estimate will prevent emotional contagion.

One may also understand how national antipathies may originate and develop under thalamic stimulation and eventuate into war. Restrictions evoke anger, as experiments have demonstrated. Though it is a far cry from an infant's outburst of rage upon restriction of its movements to a nation's belligerent rage upon the restrictions of an economic boycott or a diplomatic "ring of steel," nevertheless both instances are basically alike as effects of "lower level" stimulation. To be sure, the nations have considerably more "cerebral reserve" than the infant (or an animal), yet that reserve may remain for a time largely untapped. It is only at the council table, at the court of arbitration, that the intellect has the greater sway and where it may effect a finesse of solution of national differences in the production of a "gentleman's agreement."

Similar observations apply to the problem of racial discord. History bears abundant witness to the fact that whenever any racial group suffers the frustration of life, liberty, or the pursuit of happiness *that* racial group becomes fired with resentment and rage even at the risk of its own destruction. For racial unity, as national unity or religious unity, is basically emotional. The parades, the martial music, the unfurled banners, the sense of cultural worth, the conviction of racial destiny—all unite to sustain that surcharge of feeling which, like the eruption of geyser and volcano, is born of great pressures. Intellect is present, of course, but it does not lead as it does

so strikingly in those unities exemplified in scientific and philosophical organizations.

Historically, it would be very difficult, if not impossible, to single out the precise emotionalized origins of movements and events that have played a determinant rôle in national and social developments. Yet one cannot mistake the emotional currents in such events as the Crusades, the inquisition of the Church, the Dutch tulip craze, and the establishment of the Anglican Church. And, more recently, the resurgence of war fever, the 1929 speculative fever, the atavistic persecution of racial minorities furnish graphic examples of emotional determinants of social trends.

Moreover, political campaigns amply illustrate thalamic dominance. To paint the political opposition with colorful adjectives—red, black, yellow—for the sake of amassing votes whereby to gain or to remain in office is not the manner of the cerebrum. And even the "bread-and-butter" appeal is more likely to be emotional than rational. Certainly, the wild gesticulations, the tremulous vocal inflections, as well as the ingratiating handshakes all too effectively evoke thalamic responses at the expense of cerebral.

Again, every courtroom lawyer carries with him his emotional bag of tricks, for he well knows the human susceptibility to fear and hate and sympathy. It takes a great deal of intellect upon the part of jurymen to resist the emotional suggestiveness of vividly drawn word pictures designed to elicit the choking sob, the gnashing of teeth, and the throbbing of breast. And when these conditions operate to effect the release of guilty men and women one can scarcely estimate the disruptive consequences within the social order.

One may readily admit, as suggested above, that in all these and similar examples the cerebral processes are not utterly in abeyance. But, except as utilized in the adroit

techniques of demagogues, religious revivalists, unscrupulous lawyers, and "high-pressure" salesmen, the cerebral processes play second fiddle, as it were, to thalamic leadership. And by this leadership, the primitive impulses of fear, rage, and love rampage over the social landscape.

INDIVIDUAL EFFECTS OF EMOTIONALIZED BEHAVIOR

In considering individual effects, one may note, in the first place, the well-known relationship between emotional excitement and digestive disturbance. Specifically, fear and anger, with their satellites of worry and disgust, are the potent factors whence a sequence of physiological disorders often originates. One can readily understand, knowing the functional arrangements of the autonomic nervous system, how this relationship occurs. If during or just prior to a meal one is greatly disturbed, the digestive processes will be inhibited for the simple physiological reason that the gastrointestinal nerves have been shut off, so to speak, in order to permit the organism to conserve energy to meet the exciting circumstance (4).

Conversely, a situation of calm or of pleasant stimulation tends to facilitate the digestive processes. Hence there is profound psychological and physiological justification for music, light-hearted conversation, and an esthetic lay-out as appurtenances to a meal. The music, of course, must not be of the kind that irritates, and the conversation must not be boresome.

In the second place, fear and anger are quite inimical to clear and effective thinking. As distractions of thought they are notorious. One should therefore take cognizance of the need for an intellectual environment that is as free as possible from all stimuli of an emotion-provoking character. In this regard, the perturbations actuated by erotic stimuli vie with fear and anger to engross attention.

Here, too, one may well note the enormous potency of worry as a distractor of thought and as a destroyer of morale. Life, as has been observed, is pregnant with conflict. But it is not conflict in itself that destroys morale; it is the faulty attempts to resolve conflict. Worry is one of these faulty attempts, faulty because fruitless; and an attempt which reflects an inability on the part of the one worrying rightly to assess himself in terms of his circumstances. In truth, the person who worries takes himself too seriously. He is too egocentric. He either fails to realize that the world was here before he arrived or fails to see himself in the perspective of the world.

And most of the occasions of worry turn out on frank scrutiny to be quite inconsequential and preventable. One who dreads the responsibility of some task, one who broods over a social blunder, one who consumes excessive energy in making minor decisions—such a one creates a mountain out of a mole hill, and does so by virtue of a lack of true insight respecting the appropriate mode of emotional adjustment. Even in those affairs of life which may reasonably be provocative of emotional concern, as in the serious illness of a close relative, the sound psychological procedure is to eschew worry by frankly and deliberately assessing the situation as one of the possibly inevitable incidents of life. As Shakespeare has Malcolm exclaim,

> "Give sorrow words: the grief that does not speak
> Whispers the o'erfraught heart and bids it break."

And overconscientiousness is psychologically unsound in so far as it involves an attitude of brooding regret and repentance. Dunlap suggests the correct procedure in the statement: "The emotionally sound individual does not repent. He estimates his mistakes and his misdeeds intellectually, and then dismisses them as matters of the

dead past, concerning which he need take no emotional attitude whatever. He is in a position, accordingly, to profit in the future by the errors of the past, to avoid doing thereafter that which he has judged morally wrong or practically disadvantageous on the basis of his experience" (6). Thus does one attain and preserve emotional stability.

THE CONTROL OF EMOTIONAL BEHAVIOR

The two paragraphs just preceding suggest that the problem of control is primarily a problem of psychological evaluation of the situations of daily life. But one is capable of making this evaluation only as one permits intellect to captain the ship of personality. For this evaluation, as an intellectual affair, issues from the scientific understanding of the why and wherefore of emotional behavior as observed in animal, in human infant, and in human adult.

As experiments demonstrate, emotional behavior patterns are formed or dispersed under particular environmental conditions. In a sense, therefore, one is a victim of a fear of this and of that by reason of childhood conditioning; yet one need not remain a victim in view of the discovery of methods of unconditioning and reconditioning—methods, again, which imply an intellectual grasp of the very problem of control.

Thus, to envisage this problem of control as one of intellectual evaluation, of cerebral dominance, and of insight is to provide psychological justification for ways and means of achieving emotional subordination. For example, to refer to the illustration of the theater fire, cerebral control is achieved by means of fire drills in the public schools and by talks on the development of self-control and on the dangers of losing control, so that the occurrence of the stimulus of the fire gong or the cry of "Fire!" effects an orderly, calm activity of escape. And in

personal problems of emotional seizures, as of a phobia, one gains control by a frank intellectual recognition of its origin and in some childhood incident, by welcoming it to full consciousness rather than trying to repress it, and by laughing at one's own dismay. However, if one is a neurotic, one's unrecognized wish to retain the phobia as serving some obscure purpose will inhibit an intellectual appraisal of the phobia.

Again, in matters of family disruptions, labor disputes, international fears and hatreds, and racial antipathies, attainment of emotional subjugation comes only by the intellectual route of arbitration as the sole means of assessing the issues involved.

So far as the problem of the abolition of war is concerned, one finds this problem, in terms of conditioning, also amenable to solution. But often the solution is foreclosed by the fatalistic attitude that war is ineradicable from human nature by reason of an "instinct of pugnacity." Such an attitude, however, finds no support from the experiments in conditioning. Indeed, as was noted before, the present-day psychological opinion leans decidedly away from the notion of instinct as explanatory of behavior.

But instinct or no instinct, the possibility of reconditioning human attitudes and convictions is generally taken for granted by any social program of education. If one can be educated *in* antipathies one can also be educated *out* of them. In the famous essay, *The Moral Equivalent of War,* William James long ago suggested the solution of the war problem by the method of transmuting the emotional energy of rage and hatred into the constructive activities of civilized enterprise. In so far as the problem is one of utilizing energy, there is no *psychological* reason why this energy may not be constructive rather than destructive in its effects.

As a control of emotion, mention should also be made

of the significance of change of activity and setting. Inasmuch as emotional behavior is largely a product of circumstances, this sort of control is psychologically sound. Indeed, one knows from personal experience how "a soft answer turneth away wrath" and how "music hath charms to soothe the savage breast." And what child has not experienced the subsidence of fear by the sedative tones and the comforting arms of its mother? And who has not had his "anguish of soul" assuaged by the kindly, assuring demeanor of a teacher, physician, or minister? These instances, familiar as they are, simply illustrate the determinative rôle of "setting" for the allaying, as well as for the evoking, of emotional reactions.

Change of activity and of setting is further illustrated in the rise and dispersion of the mob spirit. Here, whether in the form of a lynching, a political meeting, a labor strike, or a revival meeting, the thalamic processes are often in the ascendancy. For the entire setting—the flamboyant speeches, the lighting effects (dismal or stimulating) the sense of social and physical solidarity attained by elbow-to-elbow seating or standing arrangements—all these further the free release of emotion. And to dissipate or to prevent the resultant emotional orgy one needs but eliminate the arrangements of physical contact whereby the mob is broken up into separate individuals. As a matter of fact, one finds the radio accomplishing this very thing. No matter how flamboyant the orator or the revivalist "on the air," one fails to get emotionally wrought up while sitting in the relaxed atmosphere of one's living room.

But the effectiveness of cerebral control is perhaps illustrated nowhere better than in the performances of actors and actresses. Despite the necessity for effective portrayal of the actor's feeling himself into the situation and into the character, he does not experience the real

emotion appropriate to the scene or character. As David Belasco remarks on this point: "To assert that any actor must or even can really feel, when acting, all that he represents—assuming, of course, that he is representing any vital or even vivid emotional experience—is merely to maintain what is manifestly nonsensical. In acting, there never can be, in the very nature of things, any real feeling. . . . Nowhere are complete self-control, dominion, poise more absolutely essential to success than they are in acting, and they cannot exist where sensibility is permitted to hold sway. . . . One night when playing *Othello* in America, Salvini, as he spoke the final words, 'no way but this, killing myself to die upon a kiss,' and collapsed in his appalling simulation of death, murmured to Miss Viola Allen, the player of *Desdemona:* 'For the one hundred and third and last time this season'!" (12).

And as Stanislavsky also remarks, the actor "must present only the rough counterfeit of emotion, because emotions do not come to order. . . . A fundamental axiom, therefore, for the actor who wishes to be a real artist on the stage, may be stated thus: he must not play to produce emotions, and he must not involuntarily evoke them in himself" (30).

A final aspect of the problem of control is suggested by the observation that most of the illustrations given above pertain to the more obviously violent or "possessive" emotions. Accordingly, the question is in order: Would it be desirable to effect such a cultivation of intellectual control as to prevent completely the possibility of emotional response? This question is more than academic, inasmuch as it involves the further question of attaining and maintaining a balanced personality. In this connection there comes to mind the historical example of the stoic; for he, of all men, has left his imprint upon the fabric of personality as one who aimed to achieve the very acme of intellectual control—to the point, that

is, of annihilating emotion. For the stoic regarded the yielding to emotion as indicative of a faulty intellect; conversely, he maintained that the triumph of intellect is its indifference to emotion (32).

One might suppose that the stoic was not, as a human being, completely indifferent to all emotion or feeling. Yet, so far as his ideal of indifference is concerned, he undoubtedly represents the highest type of control. Whether or not he developed an immunity to all forms of human affection, all sentiments of righteous indignation, reverence, sympathy, or chagrin, as well as to the more insistent emotions of anger, love and fear; and whether or not he developed a complete unresponsiveness even to the empathic effects of music, poetry, and drama—these are questions of but gratuitous concern.

For us, indeed, the question is one of defining a balanced perspective of life. And this question itself is one proposable only by intellect. It would seem, therefore, that any view of a balanced life could not possibly exclude such sentiments as sympathy, sorrow, joy, indignation, and so forth. Least of all could it exclude those capabilities of thrilling to sublime orchestral music, of gazing rapturously upon some magnificent stretch of natural beauty, and of rising to heights of enthusiasm over some masterpiece of creative art. For without these capabilities, ultimately enkindled as they may be in thalamic processes, life would be infinitely less rich.

The problem of control thus becomes one of balance. One may on occasion "let go," but always with the intellect holding the reins. Even a group of scientists may wax uproarious over some discovery or may become quite disputatious over rival theories; but scientists do not sing "Sweet Adeline" in their enthusiasms, nor do they throw chairs at one another in their controversies. Discipline of emotion by intellect becomes the hallmark of maturity. No simple problem is suggested here; yet

throughout, the technique of conditioning is the psychological prescription.

SUMMARY OF THE CHAPTER

At the beginning of this chapter a number of practical questions were posed, suggesting the topical scheme of the chapter, and comprising the following points: the formation of emotional patterns, the methods of judging these patterns, the expansion of them into the varied attitudes and adjustments, their consequences for personal and social welfare, and as involving the problem of control.

As regards the formation of emotional patterns, the question of instinct arose and was referred to experimental test. This test, as carried out upon infants who have had no opportunity to acquire emotional habits, demonstrated that certain specific situations—sudden loud noise, sudden loss of support, restriction of movements, and gentle stroking and rocking—elicit natural emotional patterns of fear, rage, and love. These patterns may then be considered the basic ones from which all further emotional developments are brought about by conditioning.

Methods of judging emotional responses included the photograph and vocal inflection. By the former it was discovered that the "coarser" emotions are far more accurately judged than are the "finer" ones; by the latter, that sorrow and anger are more easily detected than fear and surprise.

Methods of testing emotional responses were then described and evaluated. The free-association test, the cardiorespiratory tests, and the psychological inventories were illustrated as devices for discovering "complexes" and feelings of guilt. The psychological principle underlying these tests is that appropriate stimuli evoke internal

disturbances or arouse associations which serve as indices of the complex or the sense of guilt.

Following upon these methods of testing was the discussion of emotionalized attitudes and adjustments. In particular, these comprise *rationalization,* including projection, self-pity, and the "sour grapes" attitude; *compensation,* including overcompensation and projection of parental ambition; and *regression.*

As for the social effects of emotionalized attitudes and adjustments, it was pointed out how fear and rage and love are prepotent in their manifestations with consequent disastrous effects when the regulative function of the cerebrum is for some reason or other temporarily discarded. Numerous illustrations of these effects were given from historical incidents, political campaigns, and courtroom tactics.

As for the individual effects of these attitudes and adjustments, cognizance was taken of digestive disturbances and mental distraction ensuing upon emotional excitement. Worry was seen to be a faulty attempt at resolving one's conflicts and its occasions to be preventable by the adoption of healthy attitudes towards the problems of life.

Finally, the problem of control was recognized as one of intellectual conditioning in the form of an understanding of the physiological and psychological processes involved, plus an insight into the untoward social and personal consequences of emotional behavior when unregulated by intellect. Intellectual control, however, does not imply the development of a "cold" personality but the development rather of a balanced personality—one that responds to a variety of feelingful situations under the supreme guidance of intellect.

QUESTIONS FOR DISCUSSION

1. Do you regard the experiments on conditioning as a crucial test of the theory of instincts? Why, or why not?
2. Take five situations or objects to which you react with fear. Can you trace the origin of these fears? Specify.
3. How would you proceed to uncondition and recondition these fears?
4. Take a particular prejudice or antipathy that you have and try to account for its origin in terms of conditioning. What do you discover?
5. Why is the concept of instinct useless? Might it be made useful? If so, how?
6. Summarize the experimental results of judging emotional expressions.
7. Describe the free-association technique. What possible applications of this technique occur to you?
8. How does an emotional state express itself in physiological forms?
9. What do you consider the possibilities are for reliably determining guilt by instrumental means?
10. Describe and evaluate the method of the inventory.
11. What illustrations from everyday life can you give to show the dominance of emotionalized attitudes?
12. How could you be sure that a given case was one of rationalization, projection, compensation, regression, and so forth?
13. Which of the emotionalized attitudes would you regard as indispensable in social living? Which not? Give reasons for your selections.
14. From a psychological viewpoint do you consider the abolition of war a feasible project? Why, or why not?
15. Take a case of worry, subject it to analysis, and suggest corrective measures.
16. Evaluate Belasco's contention.
17. Define emotional maturity. What are the earmarks, so to speak, of emotional maturity?

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PART IV

THE PSYCHOLOGY OF THINKING AND IMAGINING

CHAPTER X

THINKING

From time to time, in studying the various aspects of learning, intelligence, and emotion, suggestions as to the nature of thinking have cropped out. This was inevitable, inasmuch as the psychological activity of the organism is always in reality an indissoluble whole.

In the experiments and interpretations of learning, thinking appears as insightful adaptability in the solving of problems. On the part of animals, this insightful adaptability cannot, of course, involve language. On the part of children and adults it does. Yet if one should deny thinking to animals, one should also deny it to children in many instances; for, as was observed in the experimental study of the learning of an ape and a child, the problem-solving of the two was in many essentials the same. And if one should maintain that thinking cannot occur until language appears, then one would have to determine the *instant* of its appearance—a problem quite insuperable. For example: is the child's first utterance—"ba-ba" or "da-da"—the signal of the first thought or should one wait until the child has uttered a whole sentence?

In the discussion of intelligence, thinking appeared largely of a verbal nature. Whether or not human adult intelligence may ever be expressed in a totally non-verbal form is a question to be discussed a little later in the chapter. Possibly mechanical intelligence, in some of its aspects at least, may be carried on without verbalization.

Emotional behavior, too, is streaked with thinking.

Indeed, it has been well observed how, in the guise of all sorts of rationalizations, thinking may largely be carried on in servitude to emotion and feeling. And so subtle may this servitude be that even the most highly developed intellects may fail at times to distinguish in personal conviction the promptings of feeling from the cool, clear motives of reason. One needs ever to be on one's guard against what Cohen refers to as "the facile confusion between the fanciful world of our heart's desire and the more sober world of actual existence" (3).

Recognizing, then, that thinking is a psychological abstraction, a phase of adjustment arbitrarily separated for the sake of discussion and interpretation, one may begin by briefly surveying the diverse uses of the term.

One instance of its use is in the form of mere opinion, as in the remark, "I think that Wilson was a greater president than Taft." Another use is indicative of conviction: "I think that Catholicism is the only true religion." Again, thinking may express simple expectation: "I think we shall have callers tonight." And again, as an intimation of anxiety, one may say: "I think that she will never come out of the operation alive." And yet again, thinking is often contrasted with action, as in the question, "Why don't you quit thinking and get down to work?" More akin to problem-solving is the remark, "I will think this thing through."

These uses, though overlapping to a greater or lesser degree, illustrate not merely the fact of vernacular variation; they prefigure the psychological difficulty of describing the nature of thinking. Indeed, it is the vernacular which presents the difficulty. But psychology can do no other than grapple with this difficulty and seek to obtain a clearer light upon this phase of human adjustment by the methods at its disposal. For, on the adult level at least, thinking appertains to the very warp and woof of life.

THINKING AND LANGUAGE

That, for the most part, thinking proceeds by words is a quite matter-of-fact observation. But how words came to be at all is a problem veiled in obscurity, a problem partly psychological, partly anthropological. Whether or not pre-human organisms think is, as we have noted, purely a matter of definition. Wundt maintained that animals cannot think because they have nothing to say (15). Such a restriction of thought to words, however, would obviously lead one to deny that Köhler's apes, for example, did any "thinking" in effecting their solutions of problems. Yet animals of a given species apparently do communicate with one another. A "cry of distress" evokes an activity upon the part of the herd or flock which unmistakably ensues as a consequence of the cry And students of natural history agree quite well as to the fact respecting "calls" of birds and animals, "calls" which appear to denote activities of mating, food-getting, and so forth. Certainly, communication is not wholly a matter of words, for even human beings often comprehend the thoughts of their fellows through gesture, countenance, and, in the case of foreigners, tonal nuance and emphasis.

How language originated.—Though veiled in obscurity, the origin of language presents a challenging problem to students interested in the psychology of thinking. A partial solution of this problem is reflected in two notable hypotheses. One of these contends that language evolves from pre-human cries and other vocal ejaculations. These original vocalisms serve presumably to communicate situations, feelings, attitudes, and wants; for example, ejaculations of surprise and fear, anger and distress, cooings and gurglings of satisfaction, whinings of pain and anguish, and grunts of annoyance and rejection. The other hypothesis sees the evolution of language from

sounds made in imitation of those of nature—the swishing of waves, the rustling of leaves, the crackling of twigs, the patter of rain, the boom of thunder, and many other instances.

Each one of these hypotheses may supplement the other and each appears quite plausible, despite their traces of anthropomorphism. They fail, nevertheless, to explain precisely how words came to be attached to specific objects and situations, and further, how such words came into existence at all as have not the remotest linkage with either vocal ejaculations or sounds of nature.

Language as a tool of communication.—Vague as is the origin of words, it is certain that they do arise and develop as tools of communication. They are the vehicles, *par excellence,* of meaning—not alone the words themselves but the vocal inflection, too, of the one who utters them. Everyone knows that by inflection "yes" may signify "no." Consider the example: "Would you recommend Mary Doe for a teaching position?" and the answer, "Ye-e-e-s," given with a drawn-out, rising inflection. Such a mode of answering would not lend support to her candidacy. Moreover, as is also well known, one may damn a person with faint praise simply by modulating one's intonation.

And the original signification of a word often undergoes considerable modification even to the extent of bearing no relationship to the original. To illustrate: the word "teetotal" in its primary form did not mean abstention from liquor at all, but signified "take all that is staked"—a metaphorical translation of the Latin word *totum,* used as a sign on a gambling device in the form of *T-totum* (9).

Another interesting instance of change of meaning may be observed in the word "person." It is from the Latin *persona,* which means "mask." The transformation of meaning may be followed in the scheme below (10).

Philology presents many instances of like evolution and change.

1. *A*........Mask.
2. *A B*......Character indicated by a mask.
3. *B*......Character or rôle in a play.
4. *B C*....One who represents a character.
5. *C*....Representative in general.

C D..Representative of church in parish.
D..Parson.

Furthermore, language in its *written* forms undergoes remarkable development as a tool of communication. The earliest known forms exemplify attempts to convey meanings through pictorial representation of man himself and the objects of his environment. As *pictographs* and *ideographs* the earliest written forms may be recognized as the matrix of letters of the alphabet when portrayed upon a scheme of evolutionary transformation (7).

So marvelously has language developed as an instrument of meanings that one's everyday vocabulary teems with words derived from the four corners of the earth, all for the sake of attaining greater and greater precision of thought expression. Indeed, one scarcely realizes how far above the brute creation this equipment of language actually places man. For the saving of time and energy, as well as for expansion of activity, the efficacy of language passes all possibility of estimation. Not only does it serve symbolically to abbreviate action, it also serves as a substitute for action. If I wish to know whether or not a certain person is approaching my house, I need not abandon my present occupation by having to get up and look for myself but may request the person sitting by the window to look for me and convey the needful information to me. This is a simple enough advantage. When, however, one considers the enormously extended

range of verbal communication by telephone and by radio, as well as by writing and printing, one obtains a vivid idea of the incalculable superiority of language in human adjustment and of its significance for the development of a highly complex civilization.

HOW THINKING IS EXPLAINED

If there is an activity of thinking separable from its vehicles of expression in words and gestures, this activity has proved to be utterly elusive to experimental investigation. There is no way of uncovering thought except as it is formulated in language or other activity. In this respect it resembles feeling and emotion; and, like these, it vanishes in the very attempt to retain it for analysis. But the peculiar thing about thinking is its own use for investigating itself. For, curiously enough, one can think about thinking. Hence, when one undertakes to scrutinize a thought, one can do so only by using another thought, and this thought, in turn, by still another thought, and so on *ad infinitum.*

And in this circumstance lurks a vital difficulty: how can a thought investigate itself? This difficulty can be met only as the comparable difficulty with emotion was met, namely, by investigating its ways of expression. To ascertain these ways for description and explanation, four broad types of investigation have evolved: the introspective, the behavioristic, the organismic, and the logical. The first three represent the familiar approaches of modern psychology, the fourth, that of philosophy.

The introspective approach.—To illustrate this approach to the problem of thinking, one may ask: "What in detail am I directly conscious of when I think of some thing, event, or person?" For example, what happens "inside" when one just *thinks* "bubble," "trough," "mummery," "cardinal," "wheeze," "infinity," or the sentences: "Peter Piper picked a peck of pickled peppers,"

and "Negation is no longer an abstract nothing, but, as a determinate being and somewhat, is only a form on such being—it is as Other-ness." Introspectively, one will report incipient motor adjustments of lips, tongue, and throat, pictorial images of various sorts, and possibly organic sensations, as of pressure in the chest, throat, or head. The second sentence (from Hegel's *Logic*) will doubtless create what Titchener calls a "baffled motor attitude" (21).

At any rate, according to a strict introspectionist viewpoint, thinking is itself analyzable and reducible to three classes of elementary processes—sensations, images, and feelings (22). These appear to consciousness in complex forms of internal speech, vague tendencies toward movement and tension. In short, every word as thought has its motor set and imaginal structure. Thinking, then, is a psychological *structure* constituted of *elements*. Whatever it may be other than this structure—for example, meanings—is a problem not so much for psychology as for logic (see page 327).

The behavioristic approach.—The behavioristic hypothesis, as was noted in Chapter One, denies the scientific legitimacy of the introspective method and the results obtained thereby for the reason that both method and results are too subjective and hence unreliable. Behaviorism, therefore, endeavors to grapple with the problem of thinking in an "objective" manner, that is, without recourse to reports as to what goes on inside "mind" but rather by viewing thinking exclusively in terms of conditioned reflexes. These reflexes may be vocal (laryngeal) or gestural or other motor reactions.

Language, accordingly, is simply the effect of conditioning laryngeal activities. A child, for example, learns to say "cat" by hearing the word pronounced by others in connection with that visually perceived animal and by arranging the muscular parts of the larynx, tongue, and

lips to produce just that pronunciation. There is no thought "back of" the *saying* of cat. Later, when the child just *thinks* "cat," the same muscular pattern of reflexes is formed but without overt pronunciation.

Hence, according to behaviorism, there is nothing whatsoever to thinking but motor adjustments built in, or conditioned, as implicit or incipient vocalization and other organic movements. From the shouting of a command to the silent process of recalling some date in history—all is essentially vocalizing. The shouting is the *explicit* form of vocalization, thinking is the *implicit* form. So then, if instruments delicate enough to attach to the vocal cords were available, one would, so the behaviorists aver, discover a great amount of activity in one's throat during thinking (25). One experimenter has constructed a device for recording possible movements of the tongue in thinking, but the results have not been accepted as valid (20).

In lieu of adequate experimental evidence the behavioristic explanation remains highly conjectural, to say the least. The behaviorist may cite indirect evidence from the observation that young children tend to vocalize unrestrainedly, and only gradually learn not to say "out loud" everything that "pops into their heads." Parents know all too well the social embarrassment ensuing upon their offspring's spontaneous emission of what was closely guarded as a family secret. But this sort of evidence that thinking is suppressed talking is of itself quite inconclusive.

In fact, the behavioristic interpretation has been rejected by many psychologists as thoroughly untenable. McDougall offers in disproof the simple experiment of silently repeating a familiar verse or passage while counting, or while saying aloud the letters of the alphabet. Here, the vocal organs are involved in one activity, the silent process (thinking) with a different activity

(14). Woodworth maintains that thought can proceed without speech, explicit or implicit. On many occasions thought runs away from speech; the rush of ideas leaves speech fragmentary, causing one to "stumble over" one's words. Moreover, one may identify something but be unable to name it. And one can think one thing and be talking something different. These considerations suggest the improbability that thinking *is* vocalization (29).

Bühler would deny both the introspective and the behaviorist interpretations that thoughts are reducible to elements—whether sensations or reflexes. He contends that thinking is irreducible, is *sui generis*. As evidence he cites a number of awareful aspects of thinking. First, one may appreciate the *method* of achieving the solution of some problem without specific knowledge of each detail of the method. This is *awareness of rules*. Second, one form of thinking is *transitional—awareness of relationships*—as exemplified in such words as "between," "better than," "nevertheless," "among," and so forth. Third, one senses the *direction* of one's thinking as somehow distinguishable from the *material* of the thinking itself. This aspect is the *awareness of intention* (16).

Thinking is always directional; its very nature is to lead to some end or conclusion. In short, thinking cannot be adequately understood without reference to its concern with meanings. And meanings are wholly unintelligible to both introspectionism and behaviorism when these go no further than the results of analysis. As Santayana remarks, "It is not the words, any more than the action and attitude which accompany them, that are his *understanding* of the words, or his *sense* of his attitudes and action" (18).

Bode disposes of the behavioristic view on the ground that its explanation of thinking is comparable to an explanation of Hamlet with Hamlet left out. Granted the large and significant rôle played by words in think-

ing, one has still the problem of determining how words arrange themselves in appropriate order towards an inference or conclusion. "Suppose we have the verbalization, 'A is north of B and B is north of C,' how do we evolve out of this statement the conclusion that A is north of C? The words in themselves have no such magic power. Some process of 'construction' must intervene . . . which places A, B, and C in appropriate spacial relations and this 'construction' must be guided by an end" (1).

Lovejoy dispatches the behavioristic explanation as a *reductio ad absurdum.* Taking the behaviorist's own thesis that thinking is merely a sequence of muscular contractions, he points out that the very thinking of the behaviorist in propounding a theory of thinking must also be nothing but muscular contractions. Hence, to be consistent, behaviorism must hold that a series of such contractions *must know itself* as muscular contractions! But this view of the matter is utterly contrary to the nature of thinking, inasmuch as thinking goes far beyond the limitations of muscular movements (limited to the larynx, for example) to compass the distant in space and the remote in time. And it is nonsensical to suppose that one's own *recognition* of muscular movements is itself a muscular movement or series of such movements. Yet the behaviorist's view implies just that. But behaviorism denies that recognition or awareness has anything to do with any item of behavior and, in so denying, its theory of thinking annuls itself (13).

The organismic approach.—The assaults upon the behavioristic account of thinking call attention to the barrenness of attempts to understand thinking in terms of reduction to elements. Nothing by way of illumination is achieved by representing thinking either as a string or pattern of conscious elements or as a chain or compound of reflexes. For, as remarked above, the

essence of thinking is meaning. Consequently, any scheme of simple reductionism misses the heart of the matter. To use Bode's analogy, Hamlet is analyzed without reference to Hamlet.

The strict introspectionist, of course, contends that meaning is primarily a problem for logic; only as "context," that is, as an arrangement of elements determined by circumstance, is it a problem for psychology (2, 23). The behaviorist, too, has no place in his theory for meaning except as "one way of telling what the individual is doing," that is, a way of describing reflexes. But the behaviorist "does not believe that the word is needed or that it is useful except as a literary expression" (26). Accordingly, both introspectionist and behaviorist exclude the problem of meaning from psychology simply by virtue of their conceiving scientific problems from the primary viewpoint of analysis into elements.

From the viewpoint of the hypothesis that behavior is of the nature of an integral whole, the problem of thinking is one of meaning and one of irreducibility. An act of thinking is *a whole*—a whole capable of expansion not as a mosaic enlargement divested of meaning but as a dynamic process of developing insight. *Thinking is the activity of seeing meaning* in a situation confronting the individual. The meaning seen may be deficient or erroneous from the standpoint of mature judgment, but meaning it is notwithstanding.

Thus viewed, the problem of thinking becomes the problem of ascertaining how concepts arise and develop, and for this one must refer to investigations upon the development of thinking in childhood, adolescence, and adulthood. A brief account of these investigations now follows.

How thinking develops.—Child psychologists agree that the early thinking of a child is always concrete rather than abstract; it is concerned with the *naming* of

objects and persons. Not until about the age of ten does the child give positive evidence of ability to *conceptualize* by expressing ideas of relation. According to Piaget, a famous psychologist of childhood, children before the age of seven think only in the form of categorical statements, for example, "This is" or "that is not," and are quite unable to tell *how* or *why* they arrive at their definitions or conclusions.

From extensive observations, Piaget maintains that thinking develops through three stages: the *egocentric,* in which the individual interprets his surroundings in terms of his own feelings; the *social,* in which he learns to submerge to, and to contrast with, and to see things from the viewpoint of others; and the *object or relational stage* wherein things, events, and persons are understood in terms of logical necessity (17). These stages are roughly comparable to childhood, adolescence, and adulthood.

Thinking may thus be viewed as developing in terms of a *configurative whole through expansion of meaning*—from the simple naming of objects, through descriptions and definitions of objects in terms of practical use, to comprehensions of abstract relationships as exemplified in scientific and philosophical systems. In short, thinking begins with simple identification of sense objects and ends with manipulation of abstractions where sense materials are at a bare minimum if not actually nil. The quotation from Hegel on page 323 well illustrates the remoteness from materiality of this final form of thinking—the only sense data being the printed words.

But one must not lose sight of the fact that even on the highest level of abstract thinking one does not completely abandon the earlier levels. Thinking is here analogous to Alpine climbing. Very few persons attain the highest peaks, and they do not remain there all the time. One needs, as a human being, to maintain some

contact with the ordinary world of sense. And the mere attainment of adulthood does not necessarily imply a corresponding attainment of a high degree of thinking in terms of logical necessity. Throughout the scale of development individual differences appear, as the intelligence quotient testifies.

In general, however, the thinking of an adult differs from that of a child by richness of associative complexity; for though the child and the adult use the same words—house, train, vacation, book—the meanings conveyed by these words differ vastly. In fact, the child will identify, say, all the dolls in a medley of toys but will be quite unable to define doll-ness. To do the latter demands an ability to express oneself in symbols—an ability the child does not possess. For symbols are the tools of abstract thinking, thinking in terms of concepts rather than sense objects.

What experiments indicate.—To investigate the process of forming concepts, a number of experimental studies have been undertaken. The procedure in these studies often takes the form of presenting to a number of persons several series of complicated geometrical designs, each of which series has a nonsense syllable attached to it such as *bik, zum, vec,* and so on. The problem set for the subjects is to abstract the feature which identifies the numerous designs as members of the series or class (8, 19). Some studies, notably one by Hull, employ Chinese characters varying from very simple to very complex, as illustrated in Figure 40.

In this experiment the subjects were taught, first of all, the words denoted by each character, then, on subsequent trials, they were given the characters to translate. By this procedure, the experimenter could judge how the subjects learned to identify the characters by seeing the *common element* in a given series.

The above experiments serve clearly to demonstrate

that concept-formation consists in the identification of the basis of similarity whereby one is able to organize objects in terms of a class. It is essentially an activity of selecting, comparing, rejecting, and grouping, as one perceives the variety of objects presented, whether in a

FIG. 40
[After Hull (12) from Dashiell (30)]

laboratory or in daily life. Furthermore, the activity expresses the quality of insight, a quality which cannot be bestowed upon an individual by specialized training in concept-formation. Indeed, as Hull expressly noted, instruction in methods of discovering similarities does not appear to carry over to situations where instruction is not given.

As an interesting bypath to this discussion of the nature of thinking, we may cite Vigotsky's discovery through experiment that persons suffering from the mental disorder *schizophrenia* regress to childish modes of thinking, that is, to the level of identifying objects by

naming. These persons lose their ability to form concepts and revert to a crude literalness of meaning. For example, if asked to give the meaning of a metaphorical statement, "When the cat's away the mice will play," they insist that the statement means just what it says. Moreover, such persons express the regressive features of their thinking in appropriate behavior; a doll, for instance, is something with which to play. Vigotsky's interpretation of this regression is that earlier or childish modes of thinking remain as a *core* of thought which, as the individual matures, becomes overlaid by conceptual developments but which reasserts itself as a mode of adjustment whenever the higher intellectual functions disintegrate (24).

The logical approach.—In viewing thinking as a type of adjustment, psychology, to a marked degree, overlaps logic. And although there is a recognized division of labor between the two in so far as psychology undertakes to give the scientific account, and logic undertakes to evaluate thinking as true or false, yet this division cannot be too sharply and arbitrarily drawn, especially with respect to those instances of false thinking which lead to maladjusted behavior. In a practical sense, as Dewey recognizes, "the *psychological* and the *logical,* instead of being opposed to each other (or even independent of each other), are connected *as the earlier and the later stages in one continuous process of normal growth*" (5).

Thinking, as an aspect of normal growth, appears whenever some problem of adjustment confronts the individual; or, in other words, thinking is a product of, or is initiated by, frustration of action. Where no frustration is present, that is, whenever behavior proceeds smoothly and uninterruptedly, as in automaticity of habit, no thinking is required.

This interpretation, it will be seen, follows from an emphasis upon the dynamic conception of behavior. But

as an interpretation of logic, the problems of adjustment are intellectual; they pertain to reflective thinking, to reasoning, and they pertain, as such, to the adult level of adjustment rather than to that of the child.

One need not remark that reasoning is a vital aspect of human adjustment. The findings of intelligence testing and the reflections upon the interfusion of feeling and reason are now familiar enough. And that insight is the very sum and substance of reasoning may now be taken for granted. But psychologically and logically, the consequences of reasoning are of prime concern; for these consequences may embody a train of successful accomplishments on the part of an individual or group of individuals, or they may ramify as a series of maladaptations. For example, in solving the problems of the national budget one may disregard the logic of economics and plunge into a disastrous orgy of inflation, or one may hew rigorously to the line of that logic and thus, by balancing the budget, save the national credit.

What the process of reasoning is from the logico-psychological standpoint may be seen by following Dewey's analysis (6). This analysis discloses five steps: (*a*) the consciousness that a difficulty is present; (*b*) the location and definition of the difficulty; (*c*) suggestions of solutions; (*d*) testing the applicability of suggestions to the difficulty, and (*e*) further observation and experiment leading to a conclusion.

Most instances of problem-solving may be seen as illustrative of these five steps, though not necessarily in such regular sequence. For, as Cohen remarks, "We seldom think in straight lines" (4). In some problems the order of the steps may in part be changed; in other problems some steps may not occur at all. Heidbreder, for instance, in an experimental study of Dewey's analysis, found that the difficulty was not always felt at the outset

of undertaking a solution but sometimes after the problem was half solved, or after a period of exploratory activity. Of course, Dewey would contend that where there is no difficulty there can be no problem so far as the particular person is concerned. A situation *is* a problem when it balks action. What makes Heidbreder's experiment especially significant is the discovery that the subjects often were inclined to accept a "solution" in a rather uncritical way and to show little or no interest in verifying the particular solution. In other words, steps (*d*) and (*e*) were likely to be neglected altogether (11).

THE PROBLEM OF GOOD THINKING

The uncritical tendency, just mentioned, well exemplifies what students of human behavior recognize as inveterate human inertia. For thorough and effective thinking requires initial determination of purpose, sustained, exacting effort, and the fortitude to face whatever conclusions eventuate. Few persons there are, doubtless, who habitually carry on this high type of thinking—the pushing through to a solution and to the verification thereof—but they are the creative thinkers. The majority of persons, the great mediocre mass, appear to find contentment in thinking upon the most superficial level and in accepting the flimsiest kinds of solutions for the problems of life. Otherwise, how may one account for the myriad forms of "hokum" abroad in the land—religious, political, medical, economic, psychological, and what not—foisted upon, and eagerly appropriated by, a gullible public through newspaper, magazine, lecture platform, pulpit, radio, and schoolroom?

Certainly, against this inertia, born as it is of flabby ease, educational efforts at inculcating the scientific motive of testing one's assumptions and beliefs upon fact and upon logic make tragically little headway, even in this enlightened twentieth century.

On analysis, however, numerous reasons occur why thinking through to the effective solution of a problem is a difficult matter. Aside from tendencies to evade rigorous thinking, one may mention *inadequacy of background.* As suggested above, one's complacent acceptance of superficial evidence is often traceable to lack of appreciation of and lack of training in the scientific ways of weighing evidence. The claim that a Democratic régime always brings "hard times" is a case in point. And inadequacy of background (say, of history) may readily account for one's inability to understand Shakespeare.

Again, the effective solution of a problem may be unduly arduous by virtue of a great disarray of *heterogeneous details.* Here one may need to spend enormous energy over a protracted period in the preliminary process of disentangling the relevant from the irrelevant and then of ordering the relevant details in a manner susceptible of efficient handling. In illustration, one may cite the statistical problem of determining the causes of industrial depression, the problem of finding the cause and the remedial agent for cancer, or the problem why freshman girls do not like chemistry.

And again, thinking may be difficult by reason of the obtrusion of pertinent but *intractable facts.* It is a trite saying that "facts are stubborn"; they thwart our cherished hopes and discompose our painstakingly developed schemes of interpretation. Yet they must be reckoned with for all that. Plans ingeniously framed must often be discarded. The research of years may produce but negative results. A towering structure of scientific hypothesis may, by intrusion of incompatible facts, collapse like a house of cards, and necessitate a new construction. The history of science presents copious illustrations of the effects of intractable facts.

These explanations do not exhaust the possible ways of accounting for the difficulties of thinking or the hindrances to good thinking. Enough has been said, however to make clear how numerous insistent and practical problems, great and small, never are satisfactorily solved either because of a smug superficiality or because of inadequate conceptions of and wrong approaches to the particular problems. Indeed, it has become a commonplace judgment that even college students fail to exercise precautions in arriving at and in testing their conclusions.

And experimental studies support this commonplace judgment. It is found, for example, that college students readily become confused in their thinking by relatively simple rearrangements of data. Although students quickly recognize that one cannot conclude from the proposition, "All horses are animals," that "All animals are horses," they fail to recognize similarly that not all *X*'s are *Y*'s because all *Y*'s are *X*'s (27). Samples of materials for the testing of reasoning are presented below.

A

No good physician advertises his cures.
Dr. J. does not advertise his cures.

Therefore, (*a*) Dr. J. is a good physician.
(*b*) Dr. J. is not a good physician.
(*c*) Dr. J. is the only good physician.

B

No ctenophora possess nematocysts.
No scyphozoa possess nematocysts.

Therefore, (*a*) All scyphozoa are ctenophora.
(*b*) No scyphozoa are ctenophora.
(*c*) All ctenophora are scyphozoa.

C

All well-trained musicians have good technique.

Therefore, (*a*) No musicians who have good technique are badly trained.
(*b*) No musician with good technique is not well trained.
(*c*) No musician who is not well trained has good technique.

D

No X's are Y's; no Z's are Y's.

Therefore, (*a*) All Z's are X's.
(*b*) No Z's are X's.
(*c*) All X's are Z's.

[From Wilkins (27)]

Results of experiments with this sort of material throw an illuminative ray upon faulty thinking. In general, the farther removed from the concrete materials of everyday experience the reasoning material is the more difficult it is to handle. This discovery of experiment is directly in line with the results of intelligence testing. To think in symbolic terms requires a high level of intelligence. In fact, one finds a high correlation between success with examples of symbolic reasoning—as illustrated above—and intelligence ranking (28). And we have already noted that genuine mastery of subjects like algebra, *symbolism par excellence,* calls for a minimum I.Q. of 110.

It is possible, of course, to correct and to prevent faulty thinking in large measure by utilization of various devices, such as illustrative materials, whereby an abstruse statement becomes clear by translation into familiar experiences. In this connection, stories and analogies,

though somewhat fraught with risk of specious implications, perform a useful function. And the possibilities of diagrammatic schemes are limited only by the fertility of pedagogical insight. In the last analysis, however, the usefulness of any aid to thinking is contingent upon the subject's level of insight.

SUMMARY OF THE CHAPTER

Despite the apparent intangibility of thinking as a psychological activity, it becomes susceptible to experimental disclosure through its forms of expression. Hence the investigation of thinking necessarily looks to behavior. In this investigation, four lines of approach have been followed. The introspective method describes the activity of thought as constituted of three types of elements—sensations, images, and feelings. The behavioristic method defines thinking in terms of conditioned reflexes of vocal and gestural kinds. The organismic method denies the legitimacy of any scheme of reduction to elements as a final account of thinking. For thinking is wholeness of meaning and as such develops by expansion from simple naming of objects to abstract or symbolic organizing of vast areas of significance, as in a philosophical system. Thus thinking becomes a problem for logic as well as for psychology. Both logic and psychology, therefore, unite to elucidate the nature of thinking as the activity of seeing meaning, of organizing relationships, of reaching conclusions, and of verifying conclusions; in short, as problem-solving.

But it may with truth be said that comparatively few persons undertake to think rigorously. The reasons for this circumstance are recognized in the form of inertia, inadequate preparation or training, and faulty conceptions of the particular problem to be solved. Data from experiments confirm these reasons and suggest the necessity for simplification in the presentation of materials of

reasoning by means of analogies and other illustrative devices and in relation to level of insight.

QUESTIONS FOR DISCUSSION

1. What is the psychology of words as vehicles of meaning?

2. Formulate your own interpretation of the quotation from Hegel; then give an introspective description of your effort to see meaning in the quotation.

3. How would you estimate the cogency of the behavioristic position in contrast with the positions of the critics?

4. What, in your own words, is the force of Bode's and Lovejoy's contentions?

5. Suppose the behaviorist to contend that he is talking science whereas Bode and Lovejoy are talking philosophy, what would be your judgment of the matter at issue?

6. Illustrate Piaget's three steps.

7. In view of a common pedagogical notion that education is for the purpose of training one to think, what significance would you attach to Hull's conclusion respecting instruction?

8. Summarize and evaluate the organismic interpretation of thinking.

9. Take any problem now confronting you and note if your procedure in arriving at a solution follows the steps indicated by Dewey.

10. Would you agree that Heidbreder's discovery is typical of college students? Why, or why not?

11. Illustrate from your own experience the obstacles to effective thinking.

12. Determine the correct conclusion for each of the syllogisms on pages 335-6. How do you know that your conclusions are right?

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CHAPTER XI

IMAGINING

As IN the case of thinking, so in that of imagining, one confronts a medley of term usage. Some usages are simply synonyms for thinking, as exemplified in the expectant remark, "I imagine that he will come." Other usages imply a contrast between the real and the unreal; for example, "That's all in your imagination." This contrast, furthermore, has often a derogatory suggestiveness about it as in the remark, "He imagines himself to be the whole show in this affair." Conversely, one may use the term to suggest commendation, as in the flattering comment, "You have the imagination of a genius"; similarly in the form of a question, "Have you no imagination?"

This medley of usage would indeed occasion enormous confusion were it not for contextual indications. In speech, one identifies meaning by nuance and inflection of tone as well as by context of phrase; in reading, by phrase context alone or by precise definition. Yet, otherwise, this very medley is indicative of the psychological appropriateness of the term imagination as it characterizes the variegated and even contrary modes of expression and adjustment. Certainly, in type of productive ingenuity, the imaginative insight of a Newton differs profoundly from that of a Milton and from that of a Wagner, and each of these, in turn, from that of a Picasso or Napoleon, and as all, in turn, differ from childhood's fancies.

IMAGINATION AS THINKING AND FEELING

All imaginative construction presents a web-like composite of thought surcharged with feeling. For if, as previously defined, thinking is the activity of seeing meaning, and if the meaning seen is largely colored by feeling, as in rationalization and compensation, then the imaginative resultant embodies nothing new by way of psychological process. And if, as psychologists maintain, feeling is the motive power of behavior, then, to be sure, the imagination of a Newton is nonetheless "fired" by feeling as is that of a Wagner, though the scientific expression of the former doubtless exhibits a far less obvious feeling aspect than does the artistic expression of the latter.

Here, again, one must guard against the tendency to hypostasize terms. Feeling and thinking may be said to produce imagination but not in a way comparable to the chemist's production of water from hydrogen and oxygen. The creative genius does not draw feeling from one pocket and thought from another and derive a compound of imagination. Any such analogous reference to "mental chemistry" is of itself quite specious, despite the fact that feeling is a function of the thalamus, and, insofar, is separable from thinking as a function of the cerebrum. But there is a further fact, namely, that in behavioral expression both functions integrate as an indissoluble whole, a fact which should never be lost sight of even though common language does suggest the contrary.

WAYS OF EXPERIMENTING UPON IMAGINATION

In view of the fact that imagination may not be differentiable in reality from either feeling or thinking, it would seem that any pertinent experimental procedure here would be none other than a study of the feeling-thinking aspect of behavior. Abstractly, imagination

concerns the evocation of *images;* yet images as entities are but hypothecations of analysis. One may indeed attempt to conjure up an image of the aroma of the morning coffee, but whether or not one can image simon-pure "coffeeness" is a question reflecting the ultimate validity of introspectionist analysis.

At any rate, experimentation upon imagination originally took the form of having a subject indicate his "power of imaging" in terms of a scale of vividness (11). Thus, on a scale ranging from extreme vividness (equivalent to actuality) to extreme haziness or no image at all, one could presumably determine one's ability to revive impressions—say the shape, color, and taste of an orange, the sound of a dead relative's voice, the odor of pine woods, or the "feel" of a heavy suitcase. Often, in fact, one does exclaim, "I see it just as real as if it were right here," or, "I hear him now almost as distinctly as I did when he was present."

Results of this sort of experiment show that individuals differ quite widely in imaging ability. Some can "see" more readily than they can "hear" or "feel" or "smell" or "taste." Others can image better in some other sense than vision. Consequently, efforts have been made to classify pupils on the basis of "eye mindedness," "ear mindedness," and so forth, but without significant practical success. For one thing, there is no clear proof that the organism is so constructed as to receive impressions through some one dominant sense at the expense of other senses. For another thing, there is abundant proof that one recalls in terms of imagery according to methods of learning which incidentally vary from material to material (12, 26).

Nevertheless, ability to image vividly is a decided advantage in one's appreciation of what one reads and hears. Certainly, without this ability in marked degree one can scarcely hope to enjoy literature—whether as

poetry, drama, novel, or history. In fact, tests have shown that literary appreciation is to a degree a matter of imaging (10, 22).

Another way of experimenting upon imagination employs designs called *ink blots*. A group of such blots can readily be made by allowing a drop of ink to fall upon a sheet of paper; then, by folding the paper over as if to mop up the blot, one obtains a pattern suitable for study.

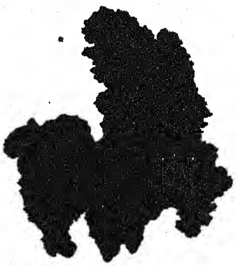

FIG. 41

FIG. 42

Here the task imposed on the subject is to describe whatever the blot may suggest to him. Figures 41 and 42 are typical.

By means of ink blots, Rorschach has contributed much information respecting individual differences of imagery. By a somewhat complicated scheme of evaluation he believes it possible not only to classify individuals into imagery types but also to define types of insanity (24). The test is revelatory at least of fertility of imagination on the part of subjects tested. Some see in the blots nothing but the most obvious and stereotyped forms. Others observe a wealth of imaginative detail, many of which naturally reflect specialized interests: one trained in botany will descry all sorts of plant forms; one trained in zoology, all sorts of animal forms; and so on (1).

Still another way of experimenting is to have an indi-

vidual develop the implications of an assigned topic. Of course this sort of thing is being done every day by teachers of composition, though not necessarily with a view to psychological standards of evaluation. Downey and Slosson have followed up this type of experiment by utilizing as material the cryptic communications of the "agony column" of the London *Times* (7). For example, a statement like "Feathers.—One on the left.—Skeine" is presented as the nucleus of a plot to be developed by the subject within a time limit of ten minutes. By the method of expert judgment the results may then be evaluated and the type of imagination determined. The authors of this experiment list six types of imagination: *inert, stereotyped, melodramatic, generalizing, particularizing,* and *ingenious* or *inventive* (8).

CREATIVE IMAGINATION

Experimental studies of the imaginal process turn out to be studies of individual constructions of meanings. These constructions express all sorts and degrees of associative combinations, from the most matter-of-fact objects to the most esoteric and nondescript patterns conceivable by human thought. Indeed, respecting the latter, there appear to be no limits to imaginal patterning, as mythology, fairy-tales, dreams, and the fantasies of the insane bear witness. Superficially, all these exemplify a psychological kinship that one might readily arrange in a linear series: Homer, Dante, Milton, Coleridge, Blake, Lewis Carroll, last night's dream, and the "brainstorm" of a dement.

Among these and others, to be sure, there are profound differences of intelligibility both as to basic purpose and cultural virtue; although this purpose and this virtue, by reason of the oft-alleged shortsightedness of contemporary critics, may not be transparent save to posterity. Thus Whistler could be branded a "coxcomb who had

flung a paint-pot in the face of the public"; thus Wagner could be refused a hearing; thus could the Wright brothers suffer ridicule; and thus could Shakespeare be ignored by some of the best scholars of his day.

The crux of this whole matter of the imagination lies in the differentiation of productive or creative and the non-productive or fantastic—a differentiation that is psychologically far from simple. For, as illustrated above, the creative often appears fantastic, and the fantastic, creative. Hence, to contrast imagination with reason in the sense that the latter deals with *real* situations and the former with *fanciful* situations is to ignore their interfusion and overlapping. Yet in common sense one does speak of the "merely fanciful" as of a different order from the "real." The "hard-headed" business man, for example, cannot tolerate the airy flights of Shelleyan romanticism nor the empyrean excursions of Platonic idealism. He, forsooth, will call a spade a spade and keep his feet on the solid earth rather than "give to airy nothing a local habitation and a name." For all that, common sense itself, when scrutinized, notoriously welters in confusion.

The upshot of this discussion is not so much to demonstrate confusion as it is to suggest the psychological thesis that the activity of imagining is essentially the *rearranging of what one already knows into new patterns.* Whether the new pattern shall be characterized as creative or as fantastic cannot be determined offhand; though some such characterization needs doubtless to be made, as will appear as the following exposition unfolds.

By creative imagination one should mean the reconstructing of familiar elements of experience into new forms under the control of fact, logic, and purpose. In other words, creative imagination is insight, the seeing of new relationships among the variegated details of experience and the expression of these new relationships in

some creation never before known to the particular individual. It is to see beyond the obvious details of immediate fact, to take from and to add to those details in such a manner as to evolve the new (4). Thus arise discoveries and inventions, artistic creations, scientific and philosophical hypotheses. These, indeed, typify the "sweep" of imagination but withal under intellectual control. Hence it may be truly said that "the man to whom nothing ever occurs, whose intellectual processes are never lit up with a spark of imagination, is unlikely to make any important discoveries" (6).

From the long catalogue of creative achievements any single instance would serve to illustrate the psychology of imagination. In the following, typical instances from three fields of human enterprise may suffice.

From the field of *invention* one may consider the procedure of Langley and the Wright brothers in solving the problem of flying. In the construction of a flying machine they were already familiar with the mechanical properties of suitable materials; they had studied the behavior of birds, and they had calculated the effects of air motion and pressure in lifting and sustaining heavier-than-air bodies. Moreover, the gasoline motor had been invented. Relating and organizing the several bits of information, these inventors conceived the problem of flying in terms of the mechanical production of air currents by means of a motor-driven propeller. Similarly, one may refer to the inventions of the cotton gin, the harvester, the phonograph, the incandescent lamp, the radio, and the photoelectric cell.

Discoveries, as distinguished from inventions, also illustrate creative imagination. The genius of a Galileo, of a Harvey, of a Pasteur, and of a Lister consists essentially in seeing far beyond their own contemporaries the possibilities of new patterns of old elements. For genius is no mystic light that flashes wheresoever it will. It is

rather the culmination of insight and of incalculable labor.

In the realm of *literary* production, Lowes has recently described the creative imagination with respect to the work of Coleridge (18). Lowes undertook the enormous labor of scrutinizing the notebook and scraps of paper upon which Coleridge had jotted down in helter-skelter the bits of information gleaned from wide reading and observation. For his labor Lowes was rewarded with the illuminating discovery of the workings of Coleridge's imagination in its creation from a chaotic miscellany of literary sources a masterpiece such as *The Rime of the Ancient Mariner*. As Lowes puts the matter, all the details of this poem were there in the "Well," the "Vision" conceived the possibility of a new pattern, the "Will" produced the result.

A vivid imagination thus turns out on analysis to consist of seeing relations in what to others is just helter-skelter, or matter-of-fact, or even nothing at all. Lowes cites the case of Ben Jonson, who informed his host that "he hath consumed a whole night in looking to his great toe about which he hath seen Tartars and Turks, Romans and Carthaginians fight in his imagination" (19).

One may easily add illustration to illustration from literature, painting, music, as well as from scientific and philosophical hypotheses in exemplification of the fact that creative insight is but the remaking of the old into the new. And although the fields of operation are quite diverse, yet they are alike in respect to the underlying psychological activity.

PHANTASY

In turning to phantasy, one meets imagination more or less running riot, so to speak, without bridle or rein of fact and logic. But this is true only in a relative sense. One may turn to one's dreams, or to the ravings of the

insane, or to the hallucinations of the delirious, or perchance to the exhibitions of modern impressionism for examples. Yet none of these is wholly uncontrolled. A nightmare may readily be understood upon analysis of the day's preoccupations. The madman's delusion may well express a clear-cut but hidden motive, as may also the wild imaginings of the fever-tortured brain. And modern impressionism may be enigmatical only to the uninitiated.

Phantasies are uncontrolled only in the sense that the particular individual appears towards them in a passive rôle. The dream, the delusion, the hallucination, the impressionistic pattern come *to* him, as it were. Hence the poet, the dramatist, and others of artistic profession sometimes regard themselves in their creativity as "inspired" from without, as experiencing a sort of dream whose source is some muse. And not alone these but also the prophets and great religious leaders, both ancient and modern, who have felt "constrained" to utter forth some message which was not of their own devising and for which they regarded themselves as the passive vehicles of communication.

Perhaps no better literary description of the rôle of phantasy can be found than that of Shakespeare in *A Midsummer Night's Dream.*

> "Lovers and madmen have such seething brains,
> Such shaping fantasies, that apprehend
> More than cool reason ever comprehends.
> The lunatic, the lover and the poet
> Are of imagination all compact:
> One sees more devils than vast hell can hold,
> That is, the madman: the lover, all as frantic,
> Sees Helen's beauty in a brow of Egypt:
> The poet's eye, in a fine frenzy rolling,
> Doth glance from heaven to earth, from earth to heaven;

And as imagination bodies forth
The forms of things unknown, the poet's pen
Turns them to shapes and gives to airy nothing
A local habitation and a name.
Such tricks hath strong imagination,
That if it would apprehend some joy,
It comprehends some bringer of that joy;
Or in the night, imagining some fear,
How easy is a bush supposed a bear!"

Dreams.—The dream, as an imaginal activity, has already received some attention in connection with the Freudian hypothesis. There we noted that interpretations of dreams are never more than plausible. Yet they do provide a perennial source of fascinating discussion. One lingers at the breakfast table to recount some vivid dream which, as recalled, often appears to reproduce incidents of waking life, particularly those of an emotional character. The anxieties and fears of the day carry over into sleep as dream imagery, though often distorted considerably from those of the original experience.

Again, a dream often appears to be initiated by some physiological condition occurring during sleep. A dream of freezing to death or of tramping the Arctic wastes may be traced to the exposure of one's foot by the accidental shifting of the bed covers.

McDougall cites the following: "I was lying awake one morning when a roller-blind suddenly rolled up with a loud snap. About three seconds later my companion, in an adjoining bed, opened his eyes and began to recite a dream from which, he said, he had just then awakened. The dream was of some length and complexity, but of considerable coherence; and it led up to and culminated in an accident accompanied by a loud crash. It seems necessary to suppose (and this view is borne out by other similar dreams) that the dream was constructed in the few seconds intervening between the objective noise and

the awakening of the sleeper. It thus illustrates the rapidity with which a dream may be constructed and experienced; and also the fact that the dream is thrust ready-made, as it were, into the consciousness of the sleeper" (20).

As McDougall further points out, the dream experiences tend to violate natural laws by representing events and activities that are physically impossible, such as floating over a building or being instantly transported to a distant place and even conversing with deceased persons. But the dreamer never in the dream questions the validity of it all. McDougall agrees with Jung to the extent that in dreaming "We regress to a lower, more primitive form of thinking which tends to be conducted mainly in the form of, and by the aid of, visual images rather than by the aid of words, especially words of highly abstract and general meaning" (21).

Reverie.—Reverie, or daydreaming, has somewhat the same characteristics as nocturnal dreaming, although in the former we are more or less aware of our surroundings. The psychoanalysts regard reverie also as a means of expressing unfulfilled desires. The thwarted lover may daydream of sexual conquests. The poor factory worker may indulge in compensatory fancies of expensive clothes and a fine car. The inhibited child may in imagination be carefree and indulgent of every whim. As aids to this sort of imagination, the novel, the drama, and the movie are notoriously effective.

Bleuler has suggested the name "autistic thinking" as denotative of fanciful imagination (2). It is the very antithesis of logical and factual thinking inasmuch as it breaks through the restraints of fact and logic and revels in unbridled wishfulness. And herein lies its danger. For the individual is apt to substitute imaginal satisfactions altogether for those satisfactions which come only through arduous toil and sacrifice. To avoid the normal

and irksome responsibilities of life by taking refuge in this sort of escape is to unfit one for successful social adaptations. The matter, of course, is one of degree. Building "castles in Spain" may be an innocent enough pastime and may even provide the relaxation necessary for the germination of an idea that eventually would prove fruitful. The other side of the picture, however, is of a most serious character. The chronic daydreamer may be exhibiting the early symptoms of the mental disorder known as *schizophrenia.*

Insanity.—Schizophrenia, or *dementia praecox,* is characterized as a regressive abandonment of the normal contacts and interests of life for a life of pure phantasy. Among psychiatrists there is much dispute concerning its causal factors: some are inclined to the view that degeneration of brain structure is responsible, others claim the disorder to be *psychogenic,* that is, a consequence of faulty character development.

At any rate, the discovery has been made that such cases sometimes respond to therapeutic administration of *sodium amytal* and come temporarily out of their stuporous condition into a fairly lucid state. On being questioned while in this lucid state they give evidence of having lost themselves in some prolonged dream or sequence of dreams which appear to be so satisfying as to prevent reëstablishment of social relationships.

Striking illustrations of fantastic thinking are observed in the form of *delusions.* Numerous types of insanity are characterized by delusional ideas, but there is one type for which delusions are the central feature. This is the type designated *paranoia.* For this type no physical signs of deterioration have ever been discovered whereby some organic condition may be isolated as the causal factor. On the contrary, there is abundant evidence of an indirect sort to support the view that paranoia presents the ultimate development of the rationalizing mo-

tive in human nature. The delusions may be of a grandiose nature or they may be persecutory. In either case, it is believed by a large body of psychiatrists that the roots of the delusions may be found in a consciousness of guilt or feeling of inferiority which the rationalization itself serves effectively to conceal from the victim. As one noted psychiatrist puts the matter: "The feeling of impotence brings forth the strong words" (Bleuler).

From the viewpoint of rationalization, one may understand the penchant of paranoiacs for grandiose titles and decorations. To pose as Caesar or Napoleon or Jesus Christ or the Lord Jehovah gives one a sense of importance which satisfies oneself at least. And so impervious is the paranoiac to any sense of his own ridiculousness that to challenge him is simply to provoke his disdain and suspicion. He will maintain, against all evidence to the contrary, that he has been "framed" by lawyers or politicians or relatives and that even the physicians of the hospital in which he is confined are in league with other conspirators to deprive him of his freedom.

Because of the impenetrability of the delusional complex to any approach of logic or fact, the victims are generally considered incurable. In this respect they are comparable to any individual who, by reason of some intense prejudice, resists change of ideas. One resists either because of pride of opinion which fears to give place or because of some concealed motive of satisfaction. Doubtless the paranoiac could be "cured" if he could be brought to see that his ideas are imaginary and groundless. But this is asking a great deal of any one. Indeed, the problem seems to be one of insight.

Unrestrained imagination is noted also among the victims of *manic-depressive* insanity. In this disorder there is alternation of mood from extreme excitement to extreme depression or the reverse. There are many variations of expression. In the manic phase the victim is

apt to be very jovial and in a veritable enthusiasm of action. His attitude is then expansive and similar to the paranoiac pose of grandeur. His vocabulary flows copiously and without regard to propriety or consistency—the so-called "flight of ideas." Here is a sample of a patient's reply to a question respecting herself: "Who am I? Why I'm the mother of God, a hundred and four years, years, yes, how the time flies, flies like a bird, bird, that's me, bird of passage, take the passage through that door, door to hell where we're all going, going fast, like a train, take me home, home sweet home," and so on. In the depressed phase, the patient utters scarcely a word and presents a picture of deep dejection.

The phantasies of this type are thus seen to be those characteristic of moods. Somewhat comparable is the optimist's tendency to see the world in rosy hues and the pessimist's tendency to emphasize the hopelessness of life. Fortunately, the manic-depressive has a large chance of recovery. And again, as with the two types of insanity above, this one is interpreted by many psychiatrists as a faulty attempt to resolve unbearable conflicts within the personality.

GENIUS AND INSANITY

The poet Dryden has suggested the relation of genius to insanity in the famous line: "Great wits are sure to madness near allied." Modern studies would go farther than Dryden and produce evidence that "great wits" were not only "near allied" but often actually in the throes of madness (13, 16, 17).

But, first of all, what are we to understand by the term genius? Various meanings occur as one attempts to define the term, a circumstance which doubtless accounts for the discrepant lists of names of geniuses which any two persons might draw up. From the viewpoint of intelligence testing, a genius is one whose I.Q. is extremely

high, 140 and above. Such a person possesses unusual "gifts" as demonstrated by his ability to perform intellectual tasks of wide variety. In early life he is often singled out as a precocious child. Again, one may think of a genius as one having extraordinary ability along a single line; for example, a creative musician, painter, dramatist; one who otherwise may be quite mediocre or even inferior. Or, one may designate as a genius the individual who, although not particularly outstanding in any one ability, nevertheless had the "gumption" to grasp the significance of a set of circumstances and capitalize them to his own advantage. This, to be sure, is an ability in itself, exemplified in the financial "wizard," the shrewd business man, and certain discoverers. These individuals illustrate the common saying: "Genius is ninety per cent hard work."

Whatever the definition, genius involves social recognition. It is recognition which makes one a genius, despite the fact that the recognition may not come to the particular individual during his lifetime (17). As an exemplar of creative imagination the genius is one who, by reason of an unusual ability, organizes the chaotic imaginal elements of his fertile brain into a pattern which strikes the public fancy with admiration and awe.

From this viewpoint, the possession of a very high I.Q. is not alone or necessarily an earmark of genius. In fact, too much intellect may stifle some forms of genius by circumventing the emotionalized flights of imagination. And here is where genius finds relationship with insanity, namely, in the symptom of phantasy.

According to responsible authorities who have applied the psychiatric "yardstick" to recognized geniuses, very few of the latter have been mentally sound. The greatest geniuses include a very high percentage of psychotics and psychopaths (16, 17, 27). And the smaller and more exacting one makes the list of geniuses the higher be-

comes the percentage of the mentally unbalanced. A number of them, it appears, developed psychoses after having achieved their greatest works; of whom are Kant, Copernicus, Huygens, Stendhal, Faraday, and Linnaeus. The following died of "general paralysis of the insane": Tasso, Donizetti, Newton, Hugo Wolff, Hölderlin, and Baudelaire.

In the case of numerous geniuses, the circumstance of mental unbalance appeared not to affect their masterpieces in any direct way. This is true not only of those who developed psychoses after their period of creativity had ceased but of those also who produced their great works during psychotic "spells" or during psychopathic manifestations. In the case of others, their works reveal the psychopathic trends—Martin Luther, Blake, De Quincey, Nietzsche, Dostoievsky, Poe, Baudelaire, Strindberg, Schumann, Rousseau, Swedenborg, Maupassant, Manet, and Van Gogh. Some of these were notoriously addicted to drugs.

Other geniuses of reputed psychopathic make-up are Michelangelo, Beethoven, Schopenhauer, Kleist, Heine, Wagner, Platen, Bismarck, Blücher, Napoleon, Molière, and Byron (16, 17).

A notable characteristic of the genius is his excessive egocentricity. His own feelings dominate his attitudes and actions. Hence he is notoriously unsociable and irritable—the so-called artistic temperament—and lives, as it were, a law unto himself. And it is this dominance by feeling which leads him to spend a considerable part of his time in the realm of the imaginary; for here in this realm he may express unrestrainedly his craving for the sensational and ecstatic and thereby obtain experiences which never come to ordinary persons. In this realm, moreover, he perceives a vista of creative possibilities which find eventual form in plastic art, in graphic

art, and in literary art, all of which embody emotional self-expression.

This self-expression reaches the *n*th degree in those art-forms called post-impressionism, cubism, and futurism. In these, imagination "runs riot" in a veritable orgy of emotional dissipation, becoming in graphic form quite undifferentiable from the "creations" of the insane. "For this embarrassing situation," Spearman remarks, "two remedies were found. One was for the artists to follow the insane. The other was for the insane to become artists. Both solutions have had their followers—with honors divided" (25).

IMAGINATION AND PLAY

Play activities comprise a large area of human interest, so large, in fact, that if they should suddenly cease upon the adult level alone, an enormous social dislocation would occur with far-reaching consequences of economic disaster. In truth, it may be said that we live to play, that we work mainly to provide the wherewithal for recreation and leisure. And here the question arises: How is play distinguished from work? On analysis one finds that they may not be distinguished by reference to the activities involved in play and work; for innumerable activities take on the character of play in some circumstances and the character of work in other circumstances. The professional sports, so far as the players themselves are concerned, are not *play* in the literal meaning of the term. And many activities ordinarily regarded as work are really of the nature of play or recreation to the participants. Hence it appears that one should rather distinguish play from work in terms of the *attitude* of the participant.

Now the play attitude is largely, if not wholly, expressive of a compensatory need (23). As such, it is akin to the daydream and to other kinds of phantasy. Upon

the childhood level one may observe the essentially make-believe character of play as a means of overcoming or sidestepping the frustrating realities of the environment. One of these realities is the child's own sense of inferiority when in the presence of adults. Therefore, to compensate for this inferiority the child will *play* at being "papa" or "mama," the policeman, the fireman, or the gangster. With dolls and miniature houses the child may *act* the grown-up; with a stick and peaked cap he may play the policeman; and with a make-believe gun he may raid make-believe banks and commit make-believe holdups.

Thus may childish imagination go to almost any length in fulfillment of desire. The child constructs the fictitious world for the reason that the real world fails to provide opportunities for self-expression. Whenever the real world does so provide, the motive for make-believe does not arise. One need not imitate feats of strength or fancy the attainment of other satisfactions when those feats are possible or those satisfactions obtainable. We may therefore understand how fairy stories, contrary and contradictory as they may be in comparison with the real world of persons and events, do persist as a perennial source of delight inasmuch as they serve as compensations for the irksome restrictions of the adult environment. Exaggerations of simple facts and events—the well-known "lies" of children—provide the thrill of self-expression (akin to the gossiping tendency of adults), as does also the dramatic participation in the make-believe circus.

Upon the adult level similar compensatory motives underlie play activity. To be sure, much of adult play is for purposes of relaxation and salutary release from a too confined vocational concern. But the adult is by no means free from the need for compensating. As we observed in Chapter Nine, the adult's world is often

painfully restrictive and disappointingly insensible in respect to his ambitions and desires. Accordingly, some substitute outlet must be sought whereby those ambitions and desires may achieve fulfillment. And play is often necessary for just that.

CAN IMAGINATION BE CULTIVATED?

The question as to whether or not imagination can be cultivated is one of pedagogical import. On the spur of the moment, doubtless, it would be answered in the affirmative. For is not the avowed aim of certain curricular emphases precisely this one of developing imagination? At least, from the viewpoint of traditional education, as reflected in formal discipline, the assumption was strong that one's imagination is susceptible to training. And yet, on the contrary, one meets the popular notion that "poets are born, not made," that "genius will out," and that imagination is a "gift."

Psychologically, of course, imagination is simply insight when considered as an aspect of creative behavior. As such, it denotes that fundamental characteristic of learning, now familiar enough, of seeing relationships and of organizing the materials of experience into significant wholes. And as such, it cannot be inculcated. Any pedagogical device becomes useful, then, only as facilitating, not as creating, the expression of insight in the sense of ability to imagine. For experiments have repeatedly shown that subject-matter of courses of study make no material difference to rate of growth in insight or learning ability—pupils who have the most to begin with make the greatest relative progress. And experiments on concept-formation, imaginative creativity *par excellence,* suggest the significant point that the ability to see relationships cannot be cultivated no matter what the technique of instruction.

From the data of psychological experiment, the point

of departure in meeting the problem of cultivating imagination lies in providing favorable opportunities for the expression of creative imagination. The poet may be "born," whatever that means; but he must learn to express himself in adequate verbal symbols. The musician may possess a "talent," but he is not therewith relieved of the necessity for considerable training. In view of the results of studies in heredity it can be safely contended that the society which fails to provide the opportunities for genius to assert itself will ere long find itself depleted of all genius. In short, the problem is one of discovering and utilizing to the full every means, psychological, biological, political, and economic, by which individuals of promise may be discerned and aided for the fullest expansion of creative insight.

Aside from the necessity for rigorous training, creative imagination requires for its germination and fruition the leisure of an unhurried life. In other words, if one may trust the reports of creative artists themselves, "flashes of genius" occur mainly, if not exclusively, in periods of relaxation. At such times the pattern of whatever sort it may be emerges as a spontaneous whole without effort and without premonition. According to Cowell, the composer, original melodies and complete harmonies appear unexpectedly to mind. These center about some germinal theme which expands as the composer exercises his creative ingenuity under the regulation of previous training (5). And Mozart, describing his development of a composition, exclaims: "I can see the whole of it at a single glance in my mind, as if it were a beautiful painting or a handsome human being; in which way I do not hear it in my imagination at all as a succession—the way it must come later—but all at once as it were. All the inventing and making goes on in me as in a beautiful strong dream. But the best of all is the *hearing it all*

at once" (14). Similarly do literary creations emerge and develop, and similarly do mathematical and other discoveries sweep into the view of the creative imagination, but never at the mere behest of one's will nor by some waving of a magic wand called "intuition," and never without preliminary arduous toil as the prerequisite for the "flashes of genius" (3, 9).

SUMMARY OF THE CHAPTER

Experimentally, the psychologist observes the imaginal activity in introspective descriptions of vividness of recalled objects and persons, in descriptions of imagery suggested by ink-blot designs, and in plot developments of a skeletal theme. In all such experimenting the creative imagination is seen to involve the rearranging of the materials of experience into new organizations but under the regulation of fact and logic. Examples of this rearranging may be observed in the fields of invention, discovery, and artistic creation.

Imagination as phantasy expresses the lack of regulation by fact and logic. Typical are dreams, reverie, and insanity. Of the last mentioned, three types were noted in illustration of the view that delusions and other phantasies of the insane—the schizophrenic, the paranoiac, and the manic-depressive—were symptomatic of unresolved conflicts. For these types of insane the imaginative constructions develop as substitutive forms of conflict-resolution.

As for the relation of genius to insanity, the discovery has been made that a very significant proportion of those who have been acclaimed as great men have manifested to a marked degree both psychotic and psychopathic trends. Doubtless the explanation for this circumstance is to be sought in terms of an emotional instability, a condition with which creative imagination is frequently associated.

Play as involving imaginal representations is often motivated by a compensatory need. Thus, in play life, one can meet the frustrations of the real world and achieve an intense, albeit substitute, satisfaction.

Finally, in the matter of cultivating the imagination, we saw that the problem of cultivation is really one of training in insight; and insight is a term for expressing one's readiness in perceiving relationships, a readiness which is indigenous to the individual and cannot therefore be cultivated. What can be achieved by way of cultivation is the provision for the expression of creative imagination on the part of those who may be discovered to possess it as an aptitude.

QUESTIONS FOR DISCUSSION

1. What, in your judgment, underlies the alleged antipathy between science and art in the form of reason versus imagination? Is the latter distinction real?
2. Could an artist be truly creative and yet free from logical necessity? Elucidate and give examples.
3. What do you understand by the phrase: "Images as entities are but hypothecations of analysis"?
4. Give illustrations to the effect that one recalls in imagery according as one has learned.
5. Give examples to prove that literary appreciation involves ability to image.
6. What do you see in the ink-blots on page 344? Compare your results with another person's. How would you account for similarities and differences?
7. Take a work of art or product of invention and give a psychological explanation of it.
8. Give a psychological explanation of "inspiration." Would such an explanation be adequate? Why, or why not?
9. How might one distinguish a prophet from a paranoiac?
10. Under what circumstances would you regard daydreaming as healthy or unhealthy?
11. Point out the probable relationships between conflict and insanity.
12. What illustrations could you offer to support the view that too much intellect may stifle genius? What does "too much intellect" here involve?
13. Point out the relationships between genius and insanity.

Should the fact of such relationships lead to a denial of the productive worth of an insane genius? Why, or why not?

14. Illustrate from your own experience the compensatory function of play.

15. What is involved in the conclusion that imagination cannot be cultivated?

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PART V

THE PSYCHOLOGY OF PERCEIVING

CHAPTER XII

SENSING AND PERCEIVING—FIRST SECTION

THE activities of sensing and perceiving have occupied the background, so to speak, in all the topics thus far discussed. Now it is appropriate to bring them under direct examination that we may see, on the one hand, what they really are as psychological aspects of human nature, and, on the other hand, how they relate to the adjustments of everyday living.

RELATION OF SENSING TO PERCEIVING

First of all, it would be well to note that the distinction implied by the title of the present chapter is largely an artificial one. It reflects the structuralist point of view that consciousness is reducible to elemental factors of which one class is sensations. That is to say, sensing denotes mental activity at its lowest or elemental level, as instanced in one's simple awareness of being stimulated by some "force" such as light or sound; simple, that is, in so far as one attaches no meaning whatsoever to the stimulus. As soon as one identifies the stimulus as "white paper" or "musical note," for example, one is *perceiving*. Even to designate the stimulus as light or sound is to perceive rather than to sense.

Defined as an elemental activity, sensing is virtually an abstraction, an inferential result of introspective analysis. Psychologically, it may well be questioned whether there is such an activity as pure sensing, one that is utterly dissociated from all meaning. For it hardly seems possible that meaning could arise from that which is

essentially non-meaningful. It would seem, at all events, that psychological activity is nothing if not meaningful.

Moreover, as we noted in Chapter Two, the atomistic interpretation based upon introspective analysis is quite misleading. Any instance of behavior, or of experience, is in itself a whole, an organic, dynamic, meaningful totality—*not* a compound of non-meaningful bits or elements. Hence any such analogous comparison of a perception with a chemical compound—say, of water—is utterly specious (19). The chemist does demonstrably compound water from two separate elements (H and O), but the psychologist cannot analogously compound a perception—say, of an orange—for, to begin with, he has no separate elements (sensations). The latter are merely hypothetical entities.

However, we may retain the distinction in the chapter heading with the understanding that *sensing pertains to sense-organ reaction to stimuli and that perceiving pertains to the meaningful character of the reaction.* Such a distinction, though admittedly abstract from the viewpoint of organic wholeness of behavior, is made solely for convenience of study, and is not based upon any hypothecation of mental elements (25).

In the experimental approach to the study of sensing and perceiving three sciences converge—physics, physiology, and psychology. The first of these is concerned with the nature of stimuli as forms of energy—radiation, air vibrations, and so forth—which, by impinging upon sensory mechanisms, give rise to nerve impulses. The second submits an array of facts concerning the details of structure and function of the sense organs and their neural connections with the brain, muscles, and glands. The third endeavors to correlate the facts of stimulation and neural transmission in order to obtain a working knowledge of the psychological resultants in terms of behavioral adjustment.

Now psychology has been dominated by an interest in the phenomena of sensing and perceiving from its very inception as an experimental science and has accordingly amassed considerable data much of which, together with the data from physics and physiology, is far too technical for an introductory account. The present discussion of the psychology of sensing and perceiving must therefore proceed along introductory lines and include only those details essential to a working understanding of human behavior.

THE BEHAVIORAL IMPORTANCE OF THE SENSE ORGANS

Behavior is sometimes defined as a process of adjustment between an organism and its physical environment. In this process the sensory mechanisms play the rôle of intermediaries, as it were; so much so, that without them behavior would be psychologically inconceivable. Putting this rôle in the form of an oft-cited figure of speech, we may think of the sense organs as the "windows of the soul." On the lowest organic level, the protozoa, no specialized sense organs are found, but the entire protoplasmic mass is responsive to stimulation (2, 11, 7). Specialization of sensory mechanism evolves with specialization of organic structure (3). On the human level, the significance of the sensory mechanisms for adjustment is particularly impressive in cases of sensory deprivation such as the blind and the deaf.

Popularly, the senses are supposed to number five. Aristotle reputedly formulated the five-point classification, although he himself recognized that one of them—touch—was a composite, rather than a single, sense (1). However, the notion of the five senses became fixed in popular thought and, despite subsequent discoveries of other senses, remains even today an inveterate popular belief. What the number of senses precisely is depends upon one's basis of determination; that is, whether the

basis is the *kind of stimuli, type of anatomical structure, type-response,* or *introspective quality* (8). Using introspective quality as the criterion, psychologists appear to agree upon at least *ten* senses (see page 426). Physiologists, notably Herrick, have determined, in terms of type-response, as many as twenty-three senses (7). In the following discussion, we shall employ the psychological basis of differentiation (26).

CONDITIONS OF SENSING AND PERCEIVING

Two types of conditions have already been mentioned, namely, *stimuli* and *sensory mechanism.* To these a third should be added, the nervous system including the brain.

Stimuli are forms of physical energy: radiant energy (light waves) for vision, vibrations of air particles (sound waves) for hearing, mechanical pressures for touch, chemical substances for smell and taste, etc. These forms of energy are stimuli for the human organism only to a limited range and degree. In the first place, there are forms of energy to which the organism is not at all sensitive directly, for example, electromagnetic waves, ultra-violet rays, and X-rays. That we are not sensitive to these is due to the make-up of our sense organs rather than to the nature of the energies themselves. Indeed, it is well-known that the discovery of such energies came indirectly through instrumental techniques. In the second place, within a given form of energy the organism is sensitive only within precise limits. For example: the human eye can see only within the light-wave limits of .0008 to .0004 millimeter in length; the human ear can record sound-wave frequencies from about 16 to about 20,000 vibrations per second (9, 17).

Strictly speaking, the sensory mechanisms are certain delicate structures within the grosser anatomical struc-

tures of eye, ear, skin, internal organs, and so forth. These delicate structures are called *receptors,* for they are the specific structures containing the nerve fibers responsive to, or which receive, the stimuli. What these receptors are for each sense will be considered in appropriate sections. Meanwhile, let us note that their function is both selective and transmissive. Those of the eye, for example, select none but light-wave stimuli and transmit none but visual impulses even when stimulated otherwise, as by pressure on eyeball. Again, those for hearing select none but sound-wave stimuli and transmit none but auditory impulses. The appropriate or specific stimulus for eliciting a given response is called the *adequate* stimulus.

However, a given type of energy may stimulate more than one kind of receptor. Radiant energy, for instance, excites visual responses through the eye and heat responses through the skin. And experiments by Gault demonstrate that sound waves—the adequate stimuli for hearing—may be tactually responded to as vibrations (6). In such cases, the resulting conscious reaction represents a selective activity of the brain.

It is the brain, as the organ of consciousness, which really senses or perceives. To be sure, nothing could be *seen,* nothing could be *heard,* and nothing could be *felt,* regardless of appropriate receptor stimulation, until the entire process is completed from impingement of energy to excitation of brain centers. Consequently, any defect along the line—physical and physiological—will either inhibit or distort the perception.

SIGHT

When the visual receptors are adequately stimulated the conscious resultant appears as two qualities—light and color. In physical terms, these qualities are expressed and identified as vibration frequencies and as wave-

lengths; as such, however, they are not directly sensed. Hence, light and color are essentially psychological phenomena.

The visual qualities.—The term light comprises all those sensory impressions which range from the purest white to the deepest black. Between these extremes are the grays, extending from that gray which is almost white to that which is almost black. All the lights form a single (linear) series, each step representing the least perceptible difference from its neighbor, beginning with black as zero light to the whitest white visible. Note that black is not zero vision. Black is *seen;* it is a visual quality. Zero vision is just not any vision. Experimentally, the blackest black (zero light) is found in the utter darkness of the interior of a blackened cylinder. And the whitest visible white is not a physically pure white but is always seen as slightly grayish. The entire range of lights is usually designated the *achromatic series* of visual qualities and contains at least 600 discriminable steps (20, 27).

The term *color* pertains strictly to all those sense-impressions which one ordinarily identifies as red, blue, purple, orange, green, and so on. As a type of visual quality they fall into an arrangement called the *chromatic series.* This series, unlike the achromatic, embodies two dimensions, namely, *hue* and *saturation.* By hue one identifies a color as red, green, yellow, etc. By saturation one signifies the relative purity of the particular hue. The number of distinguishable hues has been estimated to be at least 150. And when to these are added all the distinguishable lights to make all degrees and combinations of hues, saturations, and intensities, the resulting number of visual qualities exceeds 500,000 (10). Such is the basic wealth of human visual experience.

All possible distinctions of quality may be represented

in relationships by means of diagrammatic schemes. Figure 43 shows in skeletal form the achromatic series. Figure 44 suggests the chromatic series. Figure 45 indicates the arrangement of all visual qualities—chromatic and achromatic in their interrelations and combinations.

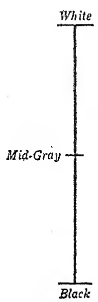

FIG. 43
Achromatic order

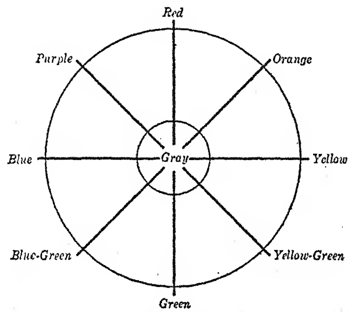

FIG. 44
Color circle

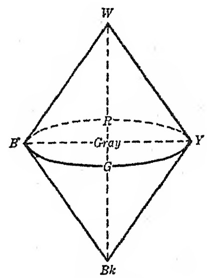

FIG. 45
Color pyramid

Complementarism.—From the above diagrams one notes that middle gray is the visual center for both qualitative series. The position of this gray is no arbitrary affair; it is a demonstrable psychological phenomenon. One knows from ordinary experience that a mixture of black and white results in gray, the character of the gray being dependent upon the proportions of the components. But one does not ordinarily know that mixtures of certain hues also result in gray. Reference to the color circle will show that each hue (only a limited number are represented, of course) has an opposite or *complementary* hue, each member of a complementary pair being represented at opposite poles of their respective diameters.

If, now, one mixes together a pair of complementaries in determinate proportions one will obtain gray as a result. In fact, if all complementaries, including black and white, are mixed together in correct proportions, gray will result. The hues, of course, must be carefully

matched according to saturation and intensity. In psychological laboratories colored disks are usually used for demonstration of mixtures.

The color pyramid portrays other relationships than those of complementarism. The peripheral line at the middle of the figure represents the line of hues at the point of greatest saturation. For each hue, saturation is observed to decrease in three directions: (*a*) towards middle gray, (*b*) towards white—revealing the *tints* of each hue, and (*c*) towards black—revealing the *shades* of each hue. As a complete geometrical solid, the pyramid would comprise every possible visual quality in correctly juxtaposed relationship.

The psychological primaries.—Inspection of the pyramid, again, shows the corners at the middle to be occupied by four hues: *red, green, yellow,* and *blue.* These are the psychological primaries, so designated on the basis of introspective observation. For purposes of demonstration one may take the color circle or any representative series of hues. As one passes through the series—taking any hue as a point of departure—one observes certain hues to stand out as unique. Red, for example, is seen to belong both to orange and to violet but not to yellow or to blue. In other words, red and yellow are unique with respect to each other in a way that orange is not to either. The same is true respecting red, violet, and blue. And the other primaries are similarly determined.

One who is familiar with the mixing of pigments will doubtless wonder at the discrepancy between the psychologist's primaries and those of the artist. The latter designates three—red, yellow, and blue. Green he obtains by mixing yellow and blue. One need not be confused, however, upon recognizing the different materials employed for mixing. The psychologist in the laboratory obtains his primaries by mixing controlled radiation frequencies. The artist upon his palette mixes pigments,

each of which varies in composition and in absorptive power. The artist then obtains green from a mixture of blue and yellow because both of these colors contain green pigment crystals which form a residue when the blue crystals cancel the yellow (21, 28).

Visual adaptation.—It is a matter of common experience that certain hues change as twilight comes on or as a room is darkened. A piece of dry goods purchased in broad daylight will appear quite different under different intensities of illumination. In bright light reds and yellows show up better than blues and greens; in dim light the situation reverses. This change of hues relative to intensity of illumination is known as the *Purkinje phenomenon,* after the man who first experimentally investigated it. It appears to best advantage after one's eyes have become accustomed to the reduced illumination (29).

This phenomenon is a case of visual adaptation. By this is meant the tendency for the visual mechanisms to adjust to an equilibrium whenever the intensity of illumination changes. It may be noted to advantage upon entering a darkened theater from a brightly lighted exterior as well as upon coming out into the daylight after having spent some time in the darkened theater. In the first instance, one is light-adapted and therefore one has difficulty in distinguishing persons and objects—sometimes to the point of embarrassment. In the second instance, one is dark-adapted so that, on entering the lighted exterior, one is apt to be more or less dazzled. If the change of illumination is perchance very sudden and intense, the effect upon the eyes is startlingly painful.

When one is light-adapted and forthwith enters an area of reduced illumination, the attainment of equilibrium is much slower than is the case of reversed adaptation. Individual differences are found, of course. And the size of the illuminated and the non-illuminated areas

also conditions the rate of adaptation. Ordinarily, the eyes become light-adapted in from one to two minutes, dark-adapted in about twenty minutes (30). Here, dark-adapted refers to approximate total darkness. A cinema theater, for example, is never completely dark. The practical test for both types of adaptation equilibrium would obviously be the ability to discriminate the details of the visual field.

Similarly, the eyes become adapted to colors. When one has gazed upon some area of a relatively light hue such as yellow and then focuses the eyes upon a neutral background, one will see a patch of color darker than the stimulus—in the present case blue. Conversely, fixation of a dark area will induce an effect of a lighter and contrasting hue. These examples are of *negative after-sensations.* Thus, whatever stimulus is fixated for a period of time—usually twenty seconds is sufficient—the negative effect is always the complementary of the stimulus.

Sometimes a *positive* after-sensation is produced. In this case the effect is a copy of the stimulus. It may be produced by fixating a lighted mazda lamp, but its duration is much shorter than cases of negative after-sensation.

What the underlying physiological factors are for these phenomena is at present not known.

Visual contrast effects.—All such phenomena as the above are found to express laws of relationship called *laws of contrast.* These laws are as follows: (*a*) Contrast-effect is maximal with complementaries. For example, a yellow spot on a field of blue effects the enhancement of both hues. (*b*) Spatial proximity of the contrasting color areas makes for greater contrast than would be the case if they were separated by some intervening light or color. (*c*) Similarity of texture favors contrast of two opposing colors. (*d*) Absence of boundary lines results in an inten-

sification of contrast. (*e*) The greater the difference in saturation between two hues, the greater their contrast.

Thus one may see how one's perception of any object or situation becomes affected by one's sensory "set." Many of the effects of contrast, including negative after-sensations, are to a large extent overlooked in everyday experience, partly because one does not attend to them particularly, and partly because one's direction of vision is constantly changing. Nevertheless, one may discover for oneself that such effects form a significant aspect of one's daily adjustments.

Consider the rôle of advertising. The advertiser knows full well how inevitably prone the human eye is to take note of color effects. As one thumbs through a magazine looking for items of interest, one cannot escape the bold yellow in this advertisement, the insistent red in that advertisement, or the splash of vivid blue upon a background of pale yellow or orange.

Legibility and contrast.—Complementarism alone does not insure the sort of contrast necessary for maximal legibility. The factors of brightness and saturation must be considered, too. By experiment one can determine which combinations of colors induce both maximum and minimum contrast effects. The table on page 380 is based upon such an experiment.

From this table one should note especially that maximal contrast for purposes of legibility is obtained with black figures on yellow rather than white ground. This combination presents maximum *brightness* contrast. Ordinary combinations of black and white are really combinations of black and gray, a fact which becomes evident enough as one tries to read a highway sign that is a considerable distance away; for the same sign in black and yellow would be more legible at the same distance. Moreover, if the purest visible white were used as a background, the effect would be so glaring as to render legi-

TABLE XVIII.—Legibility Values of Color Combinations
[From Luckiesh (12)]

Order of value	Printed matter	Background
1 (greatest)	Black	Yellow
2	Green	White
3	Red	White
4	Blue	White
5	White	Blue
6	Black	White
7	Yellow	Black
8	White	Red
9	White	Green
10	White	Black
11	Red	Yellow
12	Green	Red
13 (least)	Red	Green

bility quite low. Again, although red and green are complementaries, they present a very poor combination for legibility simply because their brightness values are approximately equal. Other factors, of course, need to be considered such as relative saturation of figure and ground and the general environmental setting.

A further problem of interest concerns the relative efficacy of colored lights on visibility of details. The table below presents an experimentally determined order of efficiency of colored lights of photometric equality; efficiency, that is, for fine work.

TABLE XIX.—Visual Efficiency of Colored Lights
[From Ferree and Rand (4)]

Yellow (highest)
Yellow-green
Orange
Red
Blue-green
Blue (lowest)

The high efficiency of the yellows may be accounted for on biological grounds; for, doubtless, the visual re-

ceptor mechanisms evolved under conditions of sunlight and hence would achieve their greatest adaptability to those artificial lights which closely approximate sunlight. Be that as it may, the experimental results are clear in the demonstration that any sort of work requiring fine discrimination of details will be facilitated by the use of yellowish rather than reddish or bluish lights.

Color and suggestion effects.—That colors have varied and potent effects in inducing feelings and attitudes is a matter of common experience. We speak of "warm" colors—red, orange, yellow—and of "cool" colors—white, blue, green; we speak also of "advancing" and "receding" colors, of "enlivening" and "depressing" colors, of "exciting" and "calming" colors, as well as of "bold" and "modest" colors; and we arrange the furnishings of rooms, the appurtenances of dining, and the color effects of dress to express the appropriate suggestion. So potent, indeed, may the suggestion be that, despite the objective evidence of the thermometer, a room dominant with blue, for example, will be felt as cool. In general, colors of the longer wave-lengths (red, orange, yellow) are warm, advancing, bold, and exciting; those of the shorter wave-lengths (blue, blue-green, green) are cool, receding, modest, and calming. Experimentally, it can be shown that for the two colors red and blue to be estimated as equidistant from a given locus, the red must be placed beyond the blue by as much as ten per cent of the total distance (13).

Doubtless the above effects have evolved as associations in human experience. The red-orange-yellow effects point to the experience of warmth in sunshine; the blue and green effects arise from experiences of fingers and lips turning blue when cold as well as of experiences with the coolness of the blue-green ocean. These are but a few of the many probable associations which the race has

made from contact with natural phenomena. There are exceptions, to be sure; but they do not materially upset one's calculations of probable effects in matters of furnishings, for those effects, illusory as they are, manifest extraordinary consistency.

The visual mechanisms.—A knowledge of certain details of structure is necessary for an understanding of further facts pertaining to vision. The eye (Fig. 46) is

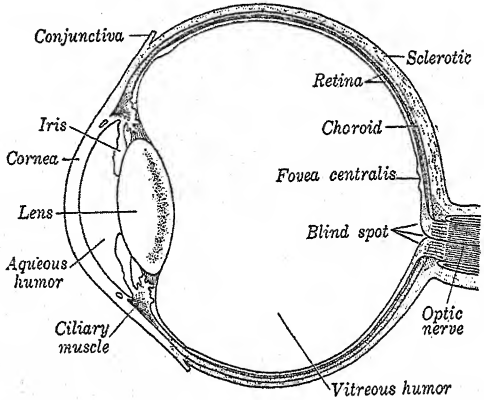

FIG. 46

often likened to a camera. It is, however, exceedingly more complex in structure than any camera yet contrived by man. Radiant energy is admitted through an aperture (pupil) which varies in size according to the intensity of the energy. The cornea is simply a transparent film of tissue. Behind the pupil is the lens through which the energy is focused and which automatically adjusts to the demands of accommodation and convergence. Beyond the lens is a jelly-like substance (vitreous humor) the function of which is to hold the eyeball in shape. In focusing the rays of energy, the lens projects an image through the vitreous humor upon the sensitized structure called the retina.

The retina itself comprises the receptor cells of vision

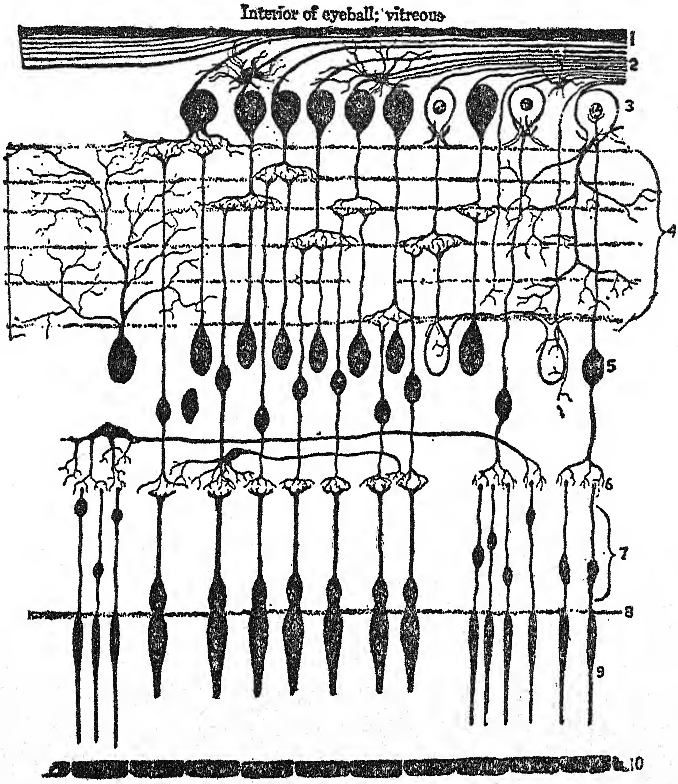

FIG. 47

Layers of the retina. Section through the retina, showing its ten layers from the vitreous to the choroid coat just inside the sclerotic: (1) inner limiting membrane, next to vitreous; (2) layer of nerve fibers; (3) layer of nerve cells; (4) inner molecular layer; (5) inner nuclear layer; (6) outer molecular layer; (7) outer nuclear layer; (8) outer limiting membrane; (9) layer of rods (long, narrow) and cones (short, thick); (10) pigment cell layer, attached to choroid. There are many thousands of rods and cones, covering the entire back inner surface of the eye; the diagram shows only a few. (From Warren, after Piersol.)

called *rods* and *cones* (Fig. 47). These cells extend about two-thirds of the distance around the interior of the eyeball. They contain the nerve fibers which branch out from the optic nerve. At the point of branching is the "blind spot," an area in which vision is totally lacking.

The area of clearest vision is called the *fovea;* it is the area of concentration of cones.

The rods and cones have been experimentally demonstrated to be the true receptors of vision. Their number is not yet known. It is known, however, that the rods outnumber the cones in certain sections of the retina in a ratio of about three to one (31). Indirect evidence indicates that the rods are for nocturnal vision, the cones for diurnal vision. Nocturnal animals, such as owls and bats, have practically no cones (22).

Perception of space and depth.—The psychological process of locating objects in space and as having the third dimension is an exceedingly complex affair, the full description and explanation of which would require the use of a very technical terminology. For elementary purposes, however, we need only concern ourselves with a minimum of essentials.

A fact of prime importance is our ability to see with either eye alone and with both eyes. Vision with one eye is referred to as *monocular,* vision involving both eyes *binocular.* Each eye has its own perceptual field, the fields overlapping in a manner to effect perception of a single object or area. In physical terms, the visual field for each eye consists of a sheaf of rays, each ray being emitted from different points and representing all the variations of color, light and shade of the particular field. It is these variations which, in part, furnish the organism with "cues" for perceiving depth and distance, inasmuch as the rays themselves vary in intensity and wave-length.

To clarify the perceptual relationships of the two eyes, one may fixate any object in the immediate field of vision—say, a book. The book, of course, is seen upon a background. Now, by fixating the book with each eye separately, one will observe differences of angular relationship between left eye-book-background and right

eye-book-background. Each eye, so to speak, has its own book and ground. Yet when both eyes fixate the same object and ground, there is but the one book and ground. The reason for this is, in simple terms, that both eyes are so coördinated that retinal fusion is effected. In other words, the two retinal images of the one object fall upon corresponding points. The resultant overlapping or coincidence of images may be represented as in Figure 48.

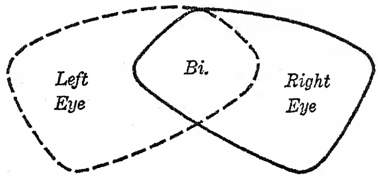

Fig. 48
The relations of the binocular and monocular visual fields. (After Witmer)

When, therefore, an eyeball is displaced, as by pressure of one's finger, the object is seen as double because the two images fall upon non-corresponding points.

Perception of space and depth, although occurring in monocular vision, is ordinarily a function of binocular vision. This function may be demonstrated by means of the *stereoscope,* an instrument contrived to present a separate plane view to each eye as each eye would see its own field. Thus fixated through a stereoscope the two views merge into a single view but with an effect of depth. This effect is illusory, of course, but it demonstrates how the combined visual contribution produces perception of depth. It suggests that depth-perception is a sort of compromise between seeing an object as single and seeing it as double (23). Curiously enough, the combined contribution involves no increase in intensity of brilliance or in saturation of color (33).

By means of the stereoscope an interesting phenomenon called *retinal rivalry* may be induced. It requires the presentation of radically different views to each eye simultaneously—views of different geometrical designs, one black and the other white, or of different hues. The

effect is a sort of visual struggle to compose into an organized pattern the disharmonious views. It is as if the brain resented disparateness and would accept none but organized totalities. Some patterns, however, do fuse into wholes; in the case of black-white components to give an effect of luster, and in the case of colors to give mixtures (24, 32, 37).

One may obtain this effect of retinal rivalry without recourse to the stereoscope. Hold the designs of Figure 49 before the eyes in such a manner that the right eye fixates the right figure and the left eye the left figure. The visual struggle will then occur in an unsuccessful attempt to merge the two designs.

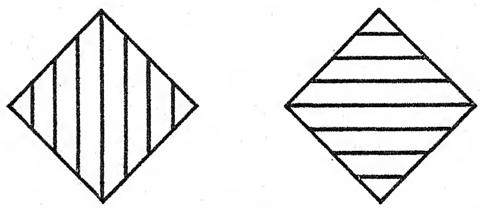

FIG. 49

Perception of movement.—In everyday life one perceives movements of objects in a variety of directions—up, down, transverse, oncoming, and receding. Sometimes movement occurs in the visual field even though one's eyes are stationary, as in watching the cinema screen, an oncoming vehicle, or waving branches. Sometimes movements of objects are accompanied by movements of one's eyes, as in watching the flight of a bird. Again, movement may be perceived while both object and eyes are stationary, as in the "phi phenomenon" to be described later.

Movement is perceived relative to a background or fixed point of reference. In the case of a moving object the rays of light cut across or displace the rays from the non-moving reference point. If, however, the eyes

move with the object, the displacement would be reversed. Moreover, this matter of eye-movement is a factor in estimating the speed of a moving object. When one's eyes are stationary, one estimates the speed of a moving object to be about twice as much as one would if one's eyes followed the object (34).

Perception of motion on the cinema screen depends upon frequency of exposure of the successive "shots." The present-day frequency is twenty-four per second, a frequency which obviates the phenomenon of "flicker" (35). However, one often observes in the projection of moving vehicles on the screen a backward rotation of the wheels. This phenomenon depends upon the number of spokes in the wheels, the speed of rotation, and also upon one's point of visual fixation. The fewer the spokes and the greater the tendency to direct vision upon the intervening spaces the more the likelihood of seeing a backward rotation (14). Furthermore, it is possible by a quick lateral movement of the eyes to break up any whole the composition of which is effected by rapid succession of impressions as is the case in cinema projection (5).

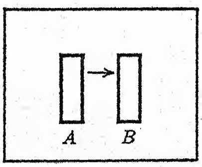

Fig. 50

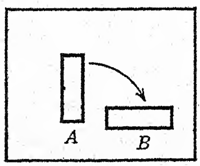

Fig. 51

The "phi phenomenon" is a case of seen movement occurring with eyes and the objects of the visual field stationary. It may readily be demonstrated by means of two cardboard screens in each of which are two slits, as illustrated in Figures 50 and 51.

A successive exposure of light through the two slits of either screen will effect a movement or passage of light

directly across the screen from *A* to *B*. In view of the fact that no stimulus is present as a moving object, the phenomenon may be considered to be of great theoretical importance for disproving the mechanistic hypothesis that for every response there must be a specific stimulus (38).

Aside from the factors mentioned in the foregoing paragraphs, there are numerous other conditions determining one's perceptions of objects, distances, and movements. These are sometimes called *psychological* conditions, in contrast with physical and physiological factors, because they are acquired in the course of experience. One has learned, for example, that *relative size* of objects provides a clue to distance. The nearer an object is, the larger it appears, and vice versa. Again, *color-saturation* influences one's judgment. Objects lose their distinctiveness of hue as they recede into the distance and take on a neutral appearance. Another condition is that of *aerial perspective.* One discovers that the nearer an object is the sharper are its outlines, and, conversely, the less distinct the outlines the farther away it is. *Linear perspective,* too, is an element of experience in perceiving depth and distance. This may be especially noted in drawings, where convergence of lines, rows of trees and columns, interception and superposition of objects in the line of vision—all serve to create the suggestion of distance and depth. And one has learned that *relative motion* is a criterion of distance. Ordinarily, the nearer an object is, the faster it appears to move.

None of the above conditions is an absolutely dependable criterion for estimating distance or movement. We shall see in a later chapter that illusoriness of perceptions is an inevitable aspect of experience. Fortunately, however, this aspect has its advantageous as well as disadvantageous side. Certainly, our enjoyment of graphic art, to mention but one instance, finds one of its sources

in the essential illusoriness of line and color arrangement as portrayed on canvas and mural.

Visual defects.—The problem of visual defects obviously pertains to the practical adjustments which an individual must perforce make in the interests both of livelihood and recreation. Although vision is not a totally indispensable instrument of adjustment, nevertheless it goes without saying that the lack of it or the deficiency of it are matters of consequence. Some kinds of visual defect are not wholly or directly apparent to those who have them, but when discovered, by test or otherwise, the deficiency may well be seen as a factor in certain maladjustments of behavior.

Color-blindness.—Though not at all a common defect, color-blindness may occasion serious social as well as personal disturbances. One need only recall in passing how great is the dependence of life and limb upon an individual's ability to respond quickly to color stimuli, as in the case of truck and bus drivers, aviators, and locomotive engineers. Fortunately, for these occupational responsibilities at least, adequate tests are administered to applicants as a routine basis for qualification.

In other occupations, tests for color-blindness might well be adopted in the interests both of employee and employer. For example, in an investigation of 373 dry-goods salesmen in San Francisco, 27 of these men were marked cases of color-blindness. And they were gaining a livelihood by selling colored fabrics! A study of their sales records showed that fifteen of these men were a distinct liability to their firms, inasmuch as their frequent errors of judgment caused considerable embarrassment to customers. One salesman, discovered to be color-blind, had the highest record of his department on the score of goods returned by disappointed customers (15).

Color-blindness varies both in extent and degree. Some

persons are blind to red, some to green, some to red and green. These are the most common types. Very rarely is a case found of blindness to blue or to yellow or to blue and yellow. And cases of total color-blindness in which the subject sees the world only in terms of the achromatic series almost never occur.

These defects are chiefly attributable to structural imperfections of the receptor cells. Hereditary transmission seems to occur in numerous families, although some cases are accounted for by incidence of retinal disease. For some unknown reason, color-blindness occurs more often among males than among females. In the recent investigation among university students (1700) the male percentage was eight and two-tenths, the female practically zero (16). Whether or not these percentages are typical of the general population remains to be ascertained. Former estimates, based upon cruder tests than those used in the above-mentioned investigation, placed the percentage for males at four and for females at less than one. From all investigations made with tests the general conclusion is that color-blindness is far more prevalent among males than among females. Studies in genetics indicate that the defect is a sex-linked phenomenon.

Many color-blind persons appear to discriminate hues, including those to which they are insensitive, upon the basis of *brightness* differences. Although subject to errors of judgment even on this basis, many persons learn in the course of experience to detect color differences fairly well.

Defects of refraction.—Normal vision (emmetropia) requires the focusing of light rays directly upon the retina. Abnormal vision appears under a variety of forms of which the following are the more common ones: nearsightedness (myopia), farsightedness (hyperopia and presbyopia), and astigmatism. These defects are trace-

able to conditions of the eye itself. In cases of short-sightedness the eyeball is too long; hence the light rays come to a focus before reaching the retina. In cases of farsightedness of the hyperopic kind the eyeball is too short, or the lens has defective curvature, causing the rays to strike the retina before coming to a focus. The farsightedness of presbyopia results from decreasing elasticity of the muscles controlling the lens, as in cases of advancing age. Astigmatism is a defect due to an unevenness of the cornea of the eye; it is a defect of double focusing of light rays.

Psychologically, the resultant blurring of vision from each of these defects is a tendency to compensate by efforts at accommodation, a tendency which brings in its train all sorts of distress—headaches, insomnia, digestive disturbances, irritability, and inability to attend to the task in hand. Fortunately, each defect is remediable by recourse to artificial lenses. Yet many cases of visual defect among school children go unrecognized so that not only do some of these children suffer unjust blame for scholastic indifference and failure but some of them develop neurotic and other personality maladjustments. After all, it is a simple matter to discover these defects.

Defects of perception.—Under this classification come the cases of word-blindness. Here the subject sees the printed words as mere sense impressions; that is, he is quite unable to interpret the words as vehicles of meanings. A somewhat rough analogy would be one's perception of Arabic or Chinese script. One *sees* something as black marks on a white page but one makes nothing of them except as black marks. Sometimes the defect pertains to individual letters in a word, sometimes to numerals, and sometimes to written rather than printed words and letters.

Aside from cases where faulty methods of learning have been discovered as the responsible factor, no ex-

planation of this defect is at present possible. The supposition that cerebral disturbances or malformations are the cause finds no confirmation from post-mortem analyses. It is known that congenital cases never learn to read. For others, careful methods of instruction effect restoration and improvement of reading ability, though no one method turns the trick. A method that proves quite effective with one child will be quite futile with another (18, 36).

SUMMARY OF THE CHAPTER

Briefly summarizing this chapter, we note, first of all, that the term sensing pertains to the occurrence of sense-organ response to stimulation and that the term perceiving pertains to the response as a meaningful affair. Psychologically, the criterion for determining a sense is distinctiveness of introspective quality. Accordingly, the number of senses possessed by the human individual is at least ten, possibly more. For each sense there is an adequate stimulus and the reaction to this stimulus is always specific.

The sense of sight has been analyzed and described with respect to two kinds of quality—achromatic (lights) and chromatic (colors). All visual experiences may be represented in terms of these qualities and their relationships shown by means of diagrams such as the color circle and the color pyramid. Adaptation occurs as a mode of equilibrium whenever the visual mechanisms are subjected to changes of intensity and hue. Adaptation, therefore, accounts for negative and positive after-sensations as well as for contrast effects. These effects have their practical significance in a variety of human interests such as advertising and interior decoration.

Analysis of the structural features of the eye reveals the relationship of these to the visual process—the cornea, pupil, lens, rods and cones of the retina and the

muscles of accommodation and convergence. Perception of space, depth, and movement depends upon the relationship of light rays to the retinal structures of both eyes and also upon the subjective factors acquired in experience.

Visual defects comprise the various forms of color-blindness, farsightedness, nearsightedness, astigmatism, and word-blindness. Adequate tests are available for discovering these defects so that in the case of those defects susceptible to correction the necessary steps may be taken to ameliorate and to prevent personality maladjustments.

QUESTIONS FOR DISCUSSION

1. What does it mean to say that sensations are merely hypothetical entities?
2. What is meant by the criterion of introspective quality as a determinant of a sense?
3. Define adequate stimulus.
4. Define hue, saturation, brightness, complementary, tint, shade, primary, adaptation, after-sensation, and contrast.
5. Why may one not obtain maximum contrast by the use of complementaries? Illustrate.
6. Illustrate the suggestion effects of color.
7. How may the phenomenon of retinal rivalry support the organismic hypothesis?
8. How may the phi phenomenon support the organismic hypothesis?
9. Illustrate the psychological conditions of distance perception.
10. Summarize the facts of visual defects.

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CHAPTER XIII

SENSING AND PERCEIVING—SECOND SECTION

We know a great deal more about the sense of sight than about other senses. For this circumstance, three reasons may be suggested: one, the supreme importance of vision in human adjustment; another, the relative accessibility of the visual mechanisms for anatomical and physiological observations; and another, the possibility of correlating anatomical and physiological data with introspective data.

As one takes up the study of other senses, one finds a relative dearth of factual knowledge. For some of these senses the receptor mechanisms are known; for some, they are merely inferential; for others, they are quite unknown. Yet for most of them the *introspective* distinctiveness is undeniable, even to the layman. One does not, for example, confuse pain with warmth, cold with nausea, or thirst with hunger. In fact, it is this introspective distinctiveness which provokes the search for anatomical and physiological correlates. Meanwhile, psychology need not wait upon anatomy and physiology; its method of introspective discrimination alone offers a fruitful and indispensable means of delineating factual data. Of course, where correlates have been established, these should be noted.

The order of senses presented in this chapter does not signify order of importance, either for science or for practical life. It would be futile to suggest such an order. Sight and hearing, to be sure, are often conjoined as the "higher" senses, at least so far as man is concerned. Yet

the distinction of "higher" and "lower" is quite relative to circumstance even in the case of man. In the theater of life, vision and hearing may have the stellar rôles; still, the effectiveness of organic adjustment depends upon the particular effectiveness of each of the senses in appropriate rôle.

HEARING

A striking difference between seeing and hearing is noted directly one observes that colors appear to the eye as separated qualities while sounds impinge upon the ear as an undifferentiated mass. One walks along the street and readily notes that a dress is green, a tie red, a hat brown, and so on; but one does not similarly note that this voice is on middle C, that whistle on high E, or that klaxon on F below middle C. Whether or not this difference is attributable to the fact that one learns in early life to identify objects in terms of color but does not learn to identify voices and other sounds in terms of pitch is a debatable matter. At all events, the difference does suggest a psychological difficulty, namely, of experimental analysis of auditory experience.

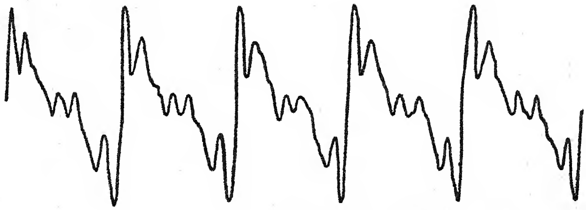
The auditory qualities.—Introspectively, auditory phenomena resolve into two classes—*tones* and *noises*. Physically, tones represent uniform frequencies of air-vibration (sound waves); noises represent complexes of irregular frequencies. Figure 52 (p. 398) illustrates characteristic vibratory differences between tones and noises.

Tones, of course, are familiarly regarded as the stuff whereof music is made, while noises are essentially non-musical. Even so, noises often embody discriminable tones. The clatter of a boiler factory, the hum of a power plant, and the roar of city traffic exhibit complexes of tone within noise. Conversation, too, is compounded of tone and noise; the tone appearing as vowel, the noise

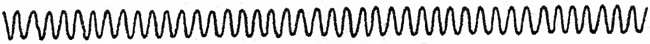
as consonant. Consider, for example, the English *ah* and the German *ach*.

Upon analysis, tones arrange in a continuous, linear series from the lowest audible pitch to the highest. On

A. Street noise



B. The vowel ah



C. A pure tone

FIG. 52

the musical scale, tones are defined in terms of pitch and are identified either by vibration-frequency (middle C, for example, is 256) or by alphabetical symbols and octave position. The number of tones discriminable by the normal ear naturally depends upon the intensity level used for testing the ear. The lower the intensity level used the narrower the tonal limits will be. Altogether, experimental analysis discloses the number of discriminable tones at different intensity levels to be about 300,000 (27). Obviously, one does not in ordinary life discriminate such a vast number, probably not more than a few thousands. The lowest audible note heard on an organ has a vibration-frequency of 16.5; the highest on the piccolo has a frequency of 4752 (1).

Besides pitch, tones possess attributes of *intensity*

(loudness), *volume* (bigness), and *brightness* (shrillness). In an organ, for example, the bass tones appear to have far more volume and far less brightness than do the treble tones. Intensity may appear throughout the tonal range, although beyond the middle range (on the piano two octaves above and two below middle C) high intensity becomes extremely unpleasant.

Practically all the tones one hears are compounds rather than single, or pure, tones. The latter may be demonstrated by means of electrically driven tuning forks, thus emitting tones of single vibration-frequencies. Compound tones emit several vibration-frequencies that are simultaneously but harmonically related as *fundamental tone* and *overtones* or *partials*. As such, tones are said to possess *timbre* or *color*. In fact, it is by timbre that we can identify a source of tone as violin, piano, clarinet, voice, and so forth. Even though a given tone or pitch be sounded by different types of instrument, yet each instrument will be recognized by its distinctive timbre.

Any simple demonstration—such as plucking a violin string or striking a piano key—will manifest the fundamental tone with its overtones, each component tone having its own vibration-frequency and recording its own pitch upon the ear. As vibration-frequencies the component pitches are arithmetically related to each other. For example: taking as fundamental pitch the C of the piano keyboard below middle C, we find its frequency to be 128; its first overtone is its *octave,* that is, middle C, whose frequency is 256, a ratio of one to two; its second overtone is *one octave and a fifth* above itself, and has a frequency of 384, a ratio of one to three; its third overtone is *two octaves* above itself, and has a frequency of 512, a ratio of one to four. Table XX shows the relationships of a fundamental tone (C) through nine of its overtones.

TABLE XX

	Pitch	Frequency	Ratio	Interval
Fundamental	C_0	128	—	——
1st overtone	C	256	1:2	Octave
2nd overtone	G^1	384	1:3	Octave and 5th
3rd overtone	C^1	512	1:4	Two octaves
4th overtone	E^2	640	1:5	Two octaves and 3rd
5th overtone	G^2	768	1:6	Two octaves and 5th
6th overtone	B flat^2	896	1:7	Two octaves and 7th
7th overtone	C^3	1024	1:8	Three octaves
8th overtone	D^3	1152	1:9	Three octaves and 2nd
9th overtone	E^3	1280	1:10	Three octaves and 3rd

As many as forty overtones have been discriminated in a given tonal complex (2). Such a composite of harmoniously related tones effects the richness of timbre which underlies the enjoyment of musical sounds.

Structural features of the ear.—The ear as a whole contains two kinds of sensory mechanisms, one of which

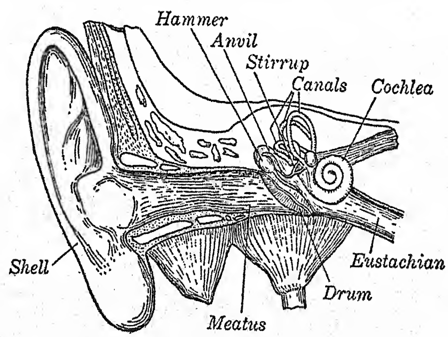


FIG. 53
Diagram of the ear. (After Warren)

is for hearing, the other for equilibrium or body balance. Figure 53 shows the gross relationships of the two mechanisms.

As an organ of hearing, the ear may be divided into three main sections. The *outer ear* comprises the ex-

ternally visible structure (variously called the *pinna,* the *concha,* and the *auricle*) and the *meatus* or passageway to the *tympanum* (ear-drum). The *middle ear* consists of three small bones called *ossicles,* familiarly known from their shapes as the *hammer,* the *anvil,* and the *stirrup.* The *inner ear* contains a spiral-shaped structure called the *cochlea* in which are the receptor cells for hearing. These cells are called *rods of Corti.* Figure 54 gives a cross-section of these rods.

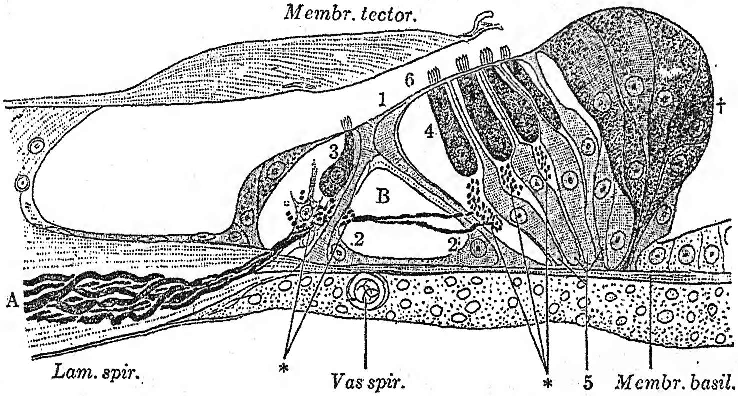


FIG. 54

Cross-section of the organ of Corti, showing nerve endings in the cochlea. Magnified probably 500 diameters. The fibers are seen emerging from the lamina spiralis, some terminating synaptically about the inner hair cells, and the remainder crossing the "tunnel of Corti" to terminate around the outer hair cells. (From Plunkett)

The number of rods has been estimated to be 23,500. And each rod projects twelve to fifteen hair fibers into the fluid substance contained within the cochlea.

How all these mechanisms effect the phenomenon of sound is not precisely known. But this is not surprising when one considers their minuteness. For the entire inner ear—cochlea and canal system—comprises an area no larger than the tip of one's little finger. In fact, one senses the whole audible range and complexity in a receptor area which, uncoiled, measures only one-fourth of

a millimeter by thirty-one millimeters (9). The really astounding thing is that much of anything at all has been discovered.

Nonetheless, the structural relationships have been fairly well established. Simply stated they are as follows. Stimuli in the form of air-vibrations enter the meatus and strike the tympanum, the resulting vibrations of which pass to the ossicles, then to the fluid of the cochlea, where displacements of the hair fibers occur, and thus give rise to nerve impulses which, on reaching the auditory centers in the brain, evoke the experience of sound.

Beats, rhythm, and melody.—A dominant characteristic of sound is *temporality,* as that of vision is *spatiality.* The color or object is "there" as long as one wishes to look at it, but the tone or noise emerges and vanishes. This aspect of temporality expresses itself as *beats* or periodic pulsations of sound. In physical terms it is explained as an alternate dampening and reinforcing of sound waves. For the normal ear the beats range in periodicity from a lower limit of one beat in 180 seconds to an upper limit of thirty beats in one second (28).

Beats vary in number as a function of the differences between the frequencies of the generating tones. For example, a tone of 260 vibrations sounded with one of 256 vibrations would produce a periodicity of four beats. Where conditions are favorable, as in a sound-proof room, it is possible for one to hear a tone carried by the beats themselves, a tone intermediate with the tones of the two generators.

Rhythm is a grouping or patterning of beats according to periodic variations of intensity. Its operation in music and dancing is too familiar to warrant more than passing notice here. But although rhythm is a necessary aspect of music, it nevertheless pertains to any sequential order of events.

Melody represents the imaginative organization of tonal and rhythmical units in sequential wholes of variegated pattern. As a sequential whole, a given melody is not merely a combination of units; it is itself a perceptual unity whose wholeness presents an irreducible experience—a qualitative totality that is more than the sum of the tonal units. Further considerations upon melody properly fall within the province of the psychology of music.

Auditory localization.—Hearing is both *monaural* and *binaural*. Hence the problem of locating the precise direction of a sound turns upon the fact that the ears lie in opposed planes. Furthermore, sound waves, unlike light waves, do not travel in a straight line; they are deflected by all sorts of objects as well as by atmospheric conditions.

Striking inaccuracies of localization may be demonstrated in a laboratory. A blindfolded subject is placed in a "sound cage" wherein sounds can be produced equidistantly from the ears, at varying intensities, and in different planes. Experiments reveal that the chief factor in aiding localization is the phase difference of the sound in arriving at the two ears (3).

Ordinarily, accuracy is facilitated by turning the head in the inferred direction, by the assistance of visual cues, as well as by familiarity with the sounds of one's customary environment. Other cues are as follows: the louder the sound the nearer it is; increasing or diminishing loudness indicates approach or recession; and modification of timbre suggests nearness or distance, the more distant a source of sound, the fewer the overtones on reaching the ears.

Auditory adaptation and contrast.—Here comparisons between visual phenomena and auditory phenomena reveal both similarities and dissimilarities. Tones, like colors, are produced by uniform vibration-frequencies;

noises, like grays, by irregular frequencies. But tones do not fall into a system of complementaries. In any complex of tones the components are always distinguishable. Harmonically, they may be said to *fuse,* but they never resolve into something else as complementary colors resolve into gray, or as colors of unlike hue resolve into a third hue. Hence there can be no adaptation to either tone or noise. Experiments involving long-continued stimulation do not indicate any tendency toward exhaustion of capacity for hearing. Nor does continued stimulation produce any after-sensations. To be sure, one may become temporarily deafened, as by the roar of an airplane motor; but this condition is not true adaptation, for one is deafened with respect to sounds other than those of the motor.

Auditory defects.—It is a commonplace observation that auditory defects have much to do with all sorts of personal maladjustments. With the exception of vision, no other sense is so important for environmental orientation than is hearing. One needs but to recall the extensive rôle played by auditory communication in the entire educative process, not to mention other important phases of life, to appreciate the enormous consequences which ensue upon defective hearing. And to a large degree these defects are remediable and preventable. In cases where they are not, at least they should be discovered early enough so that personality maladjustments may be prevented. The potential seriousness of this matter becomes acutely manifest upon the discovery that in the public schools of the United States 3,000,000 children have defective hearing (19).

Auditory deficiency ranges in degree from insensitivity to certain vibration-frequencies to total deafness. Just what the degree is for a particular case can be quickly determined by means of accurate methods of diagnosis (see Figure 55).

Somewhat analogous to color-blindness is the phenomenon of tonal-deafness. This condition expresses an insensitivity to a limited range of vibration-frequencies in the form of "tonal gaps" and "tonal islands" (15, 20). Outside these limits, the auditory acuity of a given case

FIG. 55

Western Electric Portable 3—A Audiometer for Individual Use. The degree of auditory acuity can be directly read from a scale. (From Wallin)

may be quite normal. At present, however, our knowledge of this deficiency is quite meager; no indications have appeared to suggest classification of cases in well defined types. Nevertheless, the significance of this phenomenon in the determination of musical aptitude should not be overlooked.

More common are the cases whose auditory acuity is below normal throughout the range of audible frequencies. These are the so-called "hard of hearing." For

this condition various causal factors may be found. Aside from the congenital cases, disease and injury are potent causes—especially scarlet fever, typhoid fever, syphilis, catarrhal and other local infections, and concussions.

Of particular importance is the incidence of auditory defect associated with the increasing noise of an industrialized society. The incessant pounding of stimuli upon the ears of the modern city dweller and factory worker—from motor traffic, subway and elevated trains, construction activities, factory machinery, not to mention the rattle of typewriters in a large office—is not without disturbing effects, directly upon auditory mechanisms and indirectly upon the organism as a whole.

A recent study of boilermakers reveals the alarming fact that fifty per cent develop inner-ear deafness after ten years of employment, and eighty per cent after twenty years (4). And a series of other studies shows conclusively how damaging are the effects of city noise upon the nervous system (13). Experimentally, deafness can be induced in guinea pigs by prolonged jarring and body shocks (16), so that one may at least infer what the probable effects upon the human organism would be from similar conditions. Indeed, medical records from the Great War produce unmistakable evidence of impaired hearing as an aftermath of bombardments (14).

Numerous cases of deafness are explicable in *psychogenic* terms. In these cases the deficiency may be limited to specific sounds or may extend to complete deafness. They point to some disturbance of a personality nature, for example, hysteria, and therefore serve as a means of escaping some intensely unpleasant situation. Among soldiers on the battlefield, psychogenic deafness could be readily attributed to a fear-complex motivated by an intense desire to escape the terrifying ordeal of war. For, significantly enough, many of these cases cleared up immediately upon the signing of the armistice.

Among civilians, also, some conflict is present as the causal agent. Hence, when the motivating circumstance is diagnosed, a cure may be effected by bringing the individual to a clear recognition of the disturbing factor (17).

Among school children, the psychogenic factor may appear as a chronic inattentiveness. Here bad training at home may be responsible in inducing a negative attitude towards the process of learning. Occasionally this attitude attaches to certain teachers whom the child dislikes, or it may attach to a subject which the child finds very difficult to learn. But whatever the specific cause of this inattentiveness, an enormous amount of tact is necessary if the teacher is to undertake corrective measures. The first step is to make sure that the auditory mechanisms are functioning normally. If these are found to be normal, the next step is the adoption of a corrective method appropriate to the particular case. One method consists of training the child to identify whispers; another, to identify vowel sounds. But no method is likely to be successful without copious use of sympathetic interest, encouragement, and quiet persistence on the part of the teacher.

Auditory deficiency as a characteristic of increasing age is a matter of common knowledge. Experiments show that diminishing sensitivity occurs first of all in the case of the higher pitches of the audible range. In general, the upper frequency limit for children is 20,000 vibrations per second; for individuals in the middle thirties, the limit drops to 15,000; and for individuals who have attained the age of fifty, the limit is 13,000 (18). Of course, exceptions appear; but they are not numerous enough to affect the age-trends as cited.

Auditory perception and articulation.—Analogous to the problem of visual legibility is the problem of intelligibility of speech sounds. Upon this problem telephone

engineers have made notable experiments the results of which are of great practical value in the understanding of the relation of articulation to comprehension.

In terms of vibration-frequency, the range of speech sounds lies between 75 and 5000 per second with the greatest concentration of energy below the frequency of 1000. Yet, for comprehensibility, it is the higher frequencies which count. Laboratory tests indicate that when frequencies above 1500 are eliminated, though the intensity is reduced only ten per cent, the comprehensibility is reduced thirty-five per cent (5).

A study of speech sounds, as used in ordinary conversation, reveals a wide variation in the phonetic power of vowels and consonants. The faintest vocable sound has a power value of .01 microwatt, that of the loudest, 5000 microwatts. For ninety-three per cent of speakers the microwatt range is 1 to 700. Table XXI shows the different values of common speech sounds.

TABLE XXI.—Relative Phonetic Powers of Fundamental Speech Sounds as Emitted by an Average American Speaker [After Fletcher (10)]

Sound	Power	Sound	Power	Sound	Power	Sound	Power
ó	680 (aw)	ū	310	ch	42	k	13
a	600	i	260	n	36	v	12
o	510	ē	220	j	23	th	11 (that)
á	490	r	210	zh	20	b	7
ō	470	l	100	z	16	d	7
u	460	sh	80	s	16	p	6
ā	370	ng	73	t	15	f	5
e	350	m	52	g	15	th	1 (thin)

In view of the demands of telephony, radio broadcasting, and public speaking, not to mention dramatics and ordinary conversation, the psychological significance of the above data is immensely practical. For the sounds which carry the low intensities are the ones most easily

missed by hearers, and the ones most likely to be misconstrued. In fact, at a distance of but ten feet between the lips of a speaker and the ears of a listener a sound like *th* as in *thin* is inaudible at ordinary conversational intensity.

Intelligibility of speech sounds is not merely a matter of expenditure of force; it is more a matter of *resonance.* Persons uninformed in the technique of voice production often marvel at the ease with which they understand the words of professional actors and singers—words uttered effortlessly upon a stage at a considerable distance from many of the listeners. To be sure, professional speakers have learned to articulate clearly through attention to careful pronunciation; but intelligibility might even then be lacking if they did not make full use of their resonance cavities—mouth, nose, and so on. For, other things being equal, it is resonance which affords carrying power to the voice.

Many persons are tiresome speakers and conversationalists simply by virtue of the strain they unwittingly place upon their hearers to grasp the vocables emitted. Such persons have acquired vicious habits of speaking from the throat rather than from the "mask"; or they speak with jaws held rigid and with mouth scarcely open; hence the wheezy tones, the pinched vowels, the rasping consonants, and the strangulated syllables. These are the cardinal sins in speaking; and they are readily corrected by simple attention to proper articulation and effortless utilization of resonance. Fortunately, speech correction is becoming a major enterprise in public education.

EQUILIBRIUM

Equilibrium, sometimes called the *static* sense, is the sense by which one responds to body changes in respect to gravity. In the maintenance of posture or balance,

vision is ordinarily an important factor. Yet there are numerous individuals who have to orient themselves gravitationally without the aid of vision. Cases of blindness are patent enough. But aviators and parachute jumpers, when flying or "baling out" in the clouds, gain little or no help from vision. Hence, one of the important tests for prospective aviators is one for determining the efficiency of his sense of balance.

The static qualities.—Introspective analysis of one's sense of equilibrium provides little but obscure and confusing data. For one thing, the sensations of balance are not reliably localized. In a state of balance one has no direct awareness of equilibrium, a circumstance quite unlike the phenomena of sights, sounds, odors, and so forth. Of course, when one's balance is disturbed by a change in gravitational relationships, one automatically rights oneself, doubtless in response to sensory cues from the semicircular canals; but these cues lack introspective clarity. For another thing, as suggested above, visual factors have played a large rôle as complicating elements in the total behavioral reaction of equilibrium. Dizziness, as we know, is effected by sudden change of one's gravitational relationships, as in the sudden rise or descent of an express elevator; but this condition is as much due to eye-movements as to change of position. In such circumstances one can prevent dizziness by closing the eyes during the course of the changing relationships. Then, too, suggestion plays a potent rôle, particularly on trains, ships, and airplanes.

Structural features.—We have already noted that the inner ear contains, in addition to the cochlea, a system of structures called semicircular canals. As shown in Figure 53, the canals lie in three spatial planes. Within the canals is a fluid called endolymph which becomes displaced whenever one's posture changes, whether of head

alone or of entire body. Into this fluid are receptor projections in the form of hair-cells which respond to the mechanical displacement of the fluid.

Experimental evidence for the equilibratory function of the canals is obtainable in a number of ways. For example, extirpation of a canal from the ear of a pigeon will result in the pigeon's making a "forced" movement in the direction of the missing canal. If all three canals should be extirpated, the pigeon will suffer complete loss of ability to maintain balance. Furthermore, its muscular tonicity will be seriously diminished (21).

Other evidence appears from the discovery that a large percentage of deaf-mutes have structural malformations of the entire inner ear. These individuals, moreover, are not subject to dizziness when rapidly rotated, and they fail to maintain balance if placed on a merry-go-round (38).

Adaptation and contrast.—Adaptation itself is a phenomenon of equilibrium; it is a "getting used to" a change of stimulus. In the case of the static sense, adaptation sets in when the rate of acceleration of movement, as in rotation, becomes uniform, thus permitting the endolymph, which tends to lag, eventually to catch up with the movement of the head.

Both negative and after-sensations occur. On coming to a dead stop after having been whirled about for some time, one senses a continuation of the movement, sometimes in the same, sometimes in the opposite, direction. Again, when one is suddenly thrown off balance, as by slipping on a banana skin, one automatically makes *compensatory* movements. These are of obvious biological utility, though learning doubtless enters into the process as in the case of the cyclist who compensates the physical tendency to lean outward on rounding a curve by deliberately leaning inward.

SMELL

In man, the sense of smell has undergone biological degeneration. One reason for this is to be sought in the evolutionary disparity between man's upright posture and the tendency for odors to cling to the ground and to objects close to the ground. It is a biological fact that animals which depend for orientation chiefly upon the sense of smell have relatively large olfactory mechanisms; whereas in the case of man and the birds these mechanisms are proportionately small (11). Nevertheless, the sense of smell plays no mean part in human adjustment. One's choice of foods, one's recourse to perfumes, one's avoidance of ill-smelling people, substances and localities, exemplify the effects of odors upon one's adjustments, however vestigial the sense may be (29, 22).

Olfactory qualities.—To ordinary introspection smell is notoriously confused with taste. When, for instance, one remarks at the breakfast table, "This coffee tastes good," it is more than likely that one should say, "This coffee smells good," for the dominant perceptual fact is the aroma. Even to scientific introspection the sense of smell presents difficulties, not alone by reason of confusion with taste but also by reason of vagueness of qualitative differentiation. For odors characteristically appear in promiscuous and unstable complexes.

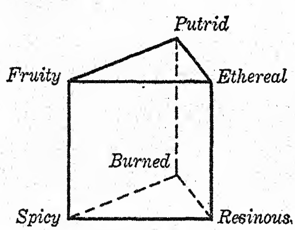


Fig. 56
Henning's olfactory prism

Despite these difficulties, psychological analysis has been assiduous in the endeavor to determine an orderly arrangement of olfactory qualities. At present there is practical agreement upon a classification embodying six principal, or primary, odors, as indicated in the diagram above, Figure 56.

Putrid odors pertain to substances such as carbon disulphide, feces, and decayed flesh; *burned* odors to tar, nicotine, pyridine; *resinous* odors to camphor, turpentine, and balsam of Peru; *spicy* to anise, pepper, and nutmeg; *fragrant* odors to heliotropine, tonka bean, and jasmine; and *ethereal* odors to oil of bergamot, lemon, and ether.

These primaries combine into all sorts of compounds and with varying intensities. For example: the odor of vanilla is compounded of the fragrant and the spicy; menthol represents a combination of the fragrant, the spicy, the resinous, and the ethereal; and celery can be analyzed into the fragrant, putrid, spicy, and the burned (30).

Structural features.—The receptors for smell are found in the upper posterior area of the nostrils in a structure called the *olfactory bulb,* as shown in Figure 57. Arrows indicate the direction of air currents.

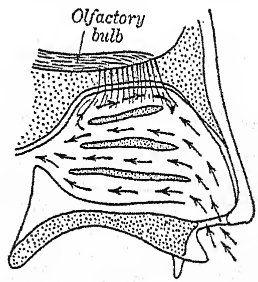


FIG. 57

The receptors are directly exposed to stimuli in the form of chemical molecules—gaseous and vaporous — which travel from odoriferous substances to and through the nostrils. Nothing is directly known about the stimuli; hence they are identified not in terms of their own nature —as in the case of light and sound—but in terms of the substances which emit them. It would be just as meaningless to refer to putrid molecules or spicy molecules as it would be to refer to red vibrations or to B flat vibrations.

About forty different substances have been identified as sources of olfactory stimuli. Many substances are inodorous—for example, the treacherous monoxide gas, and most of the chemical elements (23).

Olfactory mixture and adaptation.—A mixture of one olfactory substance with another may result in neutralization of both, in whole or in part, or in an entirely new quality. In this, smell is more akin to vision than to audition. Commercial perfumes readily exemplify effects of mixtures, as do toothpastes and mouthwashes also. Moreover, by admitting one substance to one nostril and a different substance to the other, an effect of olfactory rivalry may be obtained.

As for adaptation, common experience bears multiple witness to this effect. The odor of the tannery soon vanishes upon persistent stimulation. The chemical laboratory ceases to disturb the student. One even becomes insensitive to one's own "scent," often to one's social disadvantage. Experimentally, some odors tend to vanish on continued stimulation at a faster rate than do others even when their intensities are equal. Furthermore, adaptation to a given odor renders one insensitive to related odors. Adaptation to iodin, for example, effects adaptation to turpentine, cloves, alcohol, and eau de Cologne. Adaptation to ammonium sulphide inhibits sensitivity to hydrochloric acid and bromine (24, 31).

Apparently no after-sensations occur, either positive or negative.

Olfactory defects.—Experimental data upon olfactory deficiency are quite meager. It is known that disease and injury may destroy one's sense of smell, in whole or in part. Some persons are insensitive to specific odors, analogously to color-blindness and tonal deafness.

TASTE

The sense of taste is much more amenable to psychological and physiological analysis than is that of smell. The tongue and the mouth cavity are directly accessible for exploration with stimuli so that introspective effects

can be observed and the appropriate receptor areas outlined.

The taste qualities.—By experiment it is found that tastes arrange into a fourfold classification: *sweet, sour, salty,* and *bitter.* These may be schematically represented in a diagram called the *taste tetrahedron* as in Figure 58.

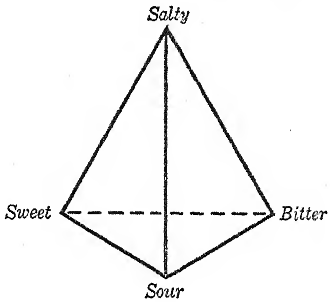


Fig. 58
The taste tetrahedron.
(After Henning)

Structural features.—The tongue, and to a certain extent the mucous membranes of the mouth and larynx, contains numerous structures called "taste-buds" in which lie the nerve endings sensitive to chemical substances dissolved in saliva. As stated above, it is a simple matter to explore the tongue with various substances and to determine precisely what the primary tastes are and where each is located in terms of specific sensitivity. Thus we find sensitivity to bitter located at the base of the tongue; sweet is found at the tip; and sour and salty lie along the edges. Anyone can easily verify these locations for himself providing he is able to ignore the suggestion-effect of knowing what particular substance is used.

Adaptation and contrast.—In taste, both adaptation and contrast are familiar experiences. The last piece of candy does not taste as sweet as the first when several pieces are eaten in succession. At table, the last spoonful of grapefruit tastes much less bitter than the first. However, the taste-buds do not become exhausted from continued stimulation as quickly as do the olfactory receptors. In general, acid or sour substances intensify the perception of sweet tastes; salty substances enhance the reaction both to sour and to sweet. No after-sensa-

tions occur. Tastes can be obliterated, however, by the use of narcotics. Even cooling the tongue with ice-water, or warming it to a temperature of forty to fifty degrees Centigrade, will inhibit all taste sensitivity except that of sour (33).

Taste and nutrition.—Troland has called attention to the physiological relationship between the sense of taste and nutritional balance. Sensitivity to sweet substances favors the intake of the sugars and carbohydrates with resultant supply of energy for body activity. Sensitivity to salty substances leads to the selection of foods containing the mineral elements needful for bone formation. On the other hand, sour substances are generally avoided or else taken in very small amounts, their acid base being inimical to body welfare. Bitter substances, as obtained in plants, are alkaloid in their effects upon the body and tend, in the form of quinine, morphine, and nicotine, to have injuriously toxic reaction upon the nervous system (32).

TOUCH

The sense of touch, or the *tactile* sense, is commonly designated the skin sense. This, however, is only true in part, for skin contains three other senses—warmth, cold, and pain, each of which has its specialized receptor mechanisms. The skin, including the epidermis and the dermis, contains two layers of sensitivity—surface and depth, for the latter continues to function even though the former be obliterated (6).

The tactile qualities.—Touch itself appears under three qualitative aspects: a sense of simple *contact* or mild pressure, induced by rumpling or depressing the surface; a sense of *tickle,* as elicited by brushing with a finger or pencil one of the hairs of the body, and a sense of vibration, as induced by means of a tuning-fork or vibrating

diaphragm applied to the skin—particularly the tips of the fingers.

Excepting the quality of vibration, tactile sensitivity is localized in the form of "spots" scattered over most of the body area. On the average, they number twenty-five to the square centimeter; on the upper arm they are as few as seven to the square centimeter, on the scalp, three hundred (24). They are practically absent from the corneas of the eyes and from the internal organs of the body.

One may discover these spots for oneself by exploring a given area of the body with a horse-hair attached to the end of a match. Careful introspection will thus reveal not only the tactile spots themselves but also a curious absence of sensitivity in various localities.

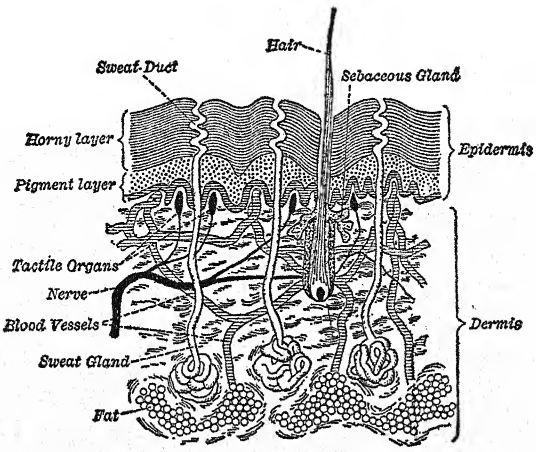


FIG. 59

Diagram of a section of the human skin. (After Eddy.) From M. F. Guyer, *Animal Biology*. Reprinted here through the courtesy of the publishers, Harper & Brothers.

Structural features.—Below the sensitive spots two kinds of receptor-structures have been discovered. Under the hairless areas of the body they are Meissner corpuscles; under the hairs they are called hair bulbs.

Figure 59 shows the various receptor mechanisms of the dermis and epidermis.

Adaptation and contrast.—Adaptation to pressure is a common experience. The pressure of one's clothes upon the body is not uniformly felt, nor is the jewelry upon one's fingers. And the caricature of the old professor searching for the spectacles which rest upon his brow finds psychological explication in terms of adaptation. Moreover, upon submerging an arm in water, or standing in water, one senses a "ring" of pressure *at* the water line; but one may not sense any pressure above or below this line.

Positive after-sensations do occur even though quite brief in duration. Upon removing one's hat, for example, one momentarily senses a "ring" about the head. And contrast-effects seem limited to differences in intensity rather than to differences of quality.

Tactile movement.—We may consider tactile perception of movement under two aspects: movement itself and texture. A familiar instance of perception of movement is the experience of having an insect crawl over one's face or arm. Experimentally, one can obtain it by having another person trace a stylus over an exposed part of one's body. One will then obtain a clear feel of movement due to the fact that a succession of tactile spots was being stimulated. Perception of texture appears as one moves an exposed part of the body over some object. In this way one obtains experience of those differential qualities ordinarily designated rough and smooth, hard and soft, dull and sharp, and so forth. The utility of these qualities is, to be sure, a matter of learning, as numerous and obvious incidents of daily life bear witness.

Tactile vibration.—That one senses vibrations is familiar enough. Finger-tips, toes, shoulder-blades, the skull, and other parts of the skeletal frame respond to

vibrations from tuning forks and other objects. And one also responds to the vibrations set up by detonations, heavy traffic, and seismological disturbances even when one fails to *hear* the accompanying sound waves.

A question of psychological moment concerns the reality of a separate sense of vibration. Admittedly, no receptor mechanisms for this alleged sense have been discovered. And introspectively, its qualitative aspects are decidedly obscure. Nevertheless, a number of differential characteristics come into view as one reflects upon the matter. In the first place, adaptation is clearly a tactual phenomenon but is not characteristic of vibration. In the second place, the tactile qualities of contact and tickle may be localized as spots whereas the vibratory quality seems to pervade the entire body or, at least, nonrestricted areas of the body. A coin placed on the back of one's hand, for example, would be definitely localized; but the unheard effects of a distant detonation would be sensed as vibrations throughout one's organism. In the third place, tactile sensitivity occurs all-at-once while vibratory sensitivity occurs as a succession. In this respect, the latter bears kinship with auditory sensitivity, a circumstance of profound practical significance, as we shall observe later, in the education of the deaf. It so happens that vibratory responses are susceptible to organization in terms of frequency relationships and that these relationships can be correlated with sound-wave frequencies (12).

Still, the tactile-vibratory relationships should not be overlooked. Introspectively, one may really perceive qualities of "roughness" or "smoothness" rather than mere vibrations, depending, of course, upon the particular frequency. Very high frequencies (2600 cycles per second) evoke the tactile perception of smoothness (34). At all events, the question as to a distinctive

vibratory sense cannot at present be answered with assurance.

TEMPERATURE SENSES

Although, in common parlance, the skin is taken to be the organ of the sense of touch, it is also regarded as the agency for quite different, and even opposed, sense qualities. Even the psychologically naïve individual recognizes the distinctiveness of simple pressure, warmth, cold, tickle, and pain. But that these were distinctive *senses,* having *specialized sense organs,* was hardly suspected before the advent of experimental psychology, despite Aristotle's apparent recognition of a variety of skin senses.

The thermal qualities.—Psychologically, warmth is no more to be conceived as absence of cold, or vice versa, than is white as absence of black. Sensorially, in both instances, they are unique with respect to each other. It is a simple matter to discover for oneself that warmth, like pressure, is sensed only in localized spots scattered over the surface of the body. The same is true of cold. A spot which, under appropriate stimulation, gives an experience of warmth will yield no other sense quality. And a spot sensitive to stimuli for cold is sensitive only as cold. By taking a metal stylus heated to forty degrees Centigrade, and exploring the skin surface with it, one will discover that sensations of warmth appear only at precisely localized spots. For cold, an ordinary lead pencil will serve as an exploratory instrument.

In number, the cold spots greatly exceed the warm, the ratio being approximately thirteen to one per square centimeter. Both, however, are distributed over the body surface in a quite irregular fashion.

Structural features.—Receptor mechanisms for both thermal senses have been isolated beneath the respective spots. For cold, the receptors are found in several kinds

of structures designated, after their discoverers, *organs of Krause, Dolgiel's corpuscles, Ruffini papillary endings,* and *Golgi-Mazzoni corpuscles.* For warmth, the receptors are *Pacini corpuscles,* and *Ruffini corpuscles.* The former are found near the surface of the skin, those of the latter much deeper in the dermis (35).

Adaptation and contrast.—If one did not know that warmth and cold were sensorially independent one would probably regard the one to be quite relative in quality to the other. And this view appears to be supported by common experience. For do we not say, with due regard to obvious limitations, that what feels cold to one person feels warm to another? Of course, suggestion enters in, too, as we noted in the discussion of color-effects. In reality, however, the respective effects of warmth and cold are determined relatively, not to each other but to a common point of departure called the *physiological zero.* This point is the normal temperature of the exposed surface of the body (28° C. or 82° F.) and is the point at which adaptation-equilibrium occurs, that is, the equalization of the heating and cooling processes. At this point no sensitivity occurs. Warmth, therefore, is experienced whenever the surface temperature rises above the physiological zero, cold, when the temperature falls below.

Accordingly, any departure from this zero, or thermal equilibrium, will occasion a compensatory effort on the part of the organism to reëstablish the equilibrium. Ordinarily, one assists the process by adding or removing clothing. Otherwise, excepting extremes, adaptation occurs as a natural phenomenon. A familiar example may be noted in the taking of a bath. Here the sensation of warmth (or cold, as the case may be) rapidly diminishes even if the water temperature remains constant.

After-sensations are also familiar experiences, especially the negative type. A reaction of coolness almost

invariably ensues upon cessation of stimulation by warmth. In fact, if one wishes to retain the sensation of warmth, one has to increase the intensity of the stimulation. Familiar, also, are the contrast-effects.

PAIN

The sense of pain has been called nature's great warning signal. As a mechanism of organic adjustment, certainly, it is of immense biological as well as psychological importance. Its character of insistence, its tendency toward intensification, and its capacity for curtailing behavior betoken its vital significance for the individual's welfare. So vital is this sense, indeed, that its absence from certain types of disease, especially in their incipient phases, renders them all the more treacherous. Hence there is great merit to the claim that pain is more the friend than the enemy of the organism. Like the barking dog which so annoyingly disturbs our slumber, it is an index of possible disaster.

The pain, or algedonic, qualities.—Experience exhibits a variety of pains—aches, stings, pricks, burns, chafing, "shooting," dragging, and so on, each more or less introspectively peculiar. Included with these is the sensation of itchiness as it occurs in tissue inflammation. Some of these pains are occasioned by mechanical pressure, extreme heat and cold, contact of acid with tissue, electrical energy, and chemical disintegration of tissue as in cancer. Even excessive stimulation of the eyes by light and the ears by sounds will elicit sensations of pain in these organs.

Structural features.—Uniquely, the receptors for pain do not lie enclosed in capsule-like structures but appear as free nerve-endings scattered throughout the body. Introspectively, pain is sensed upon the surface of the body in the form of spots. They are distributed irregularly; on the eyeball they are very dense; on the insides of the

cheeks they are scanty; on the hairless parts of the body they average fifty-four to the square centimeter; in other parts they average 175 to the square centimeter. Many parts of the body, of course, are inaccessible to direct stimulation.

Cumulative evidence that the free nerve-endings are the true receptors for pain is obtained by various techniques. For example, the cornea of the eye is found to be sensitive only to cold and pain and it has but two types of nerve-endings—the Krause bulbs and the free nerves (36). Again, it is common knowledge among the laity, as well as among psychologists and practitioners, that surgical blocking and transection of the so-called pain nerves renders the respective body areas insensitive.

Adaptation and contrast.—Strikingly enough, pain is not, even under prolonged stimulation, susceptible to adaptation. Experience bears this out. The longer the dentist drills, the longer the pain continues. Anesthetics, very probably, would not be needed if pain were like smell or taste. Again, one recalls the biological utility of this sense. To be sure, mild pains are often disregarded by the sufferer, especially if his attention becomes absorbed by some aspect of his environment that, for the time being at least, proves more compelling. Yet, as was the case with audition, this sort of thing is not true adaptation. The sense does not become exhausted through continued stimulation.

Contrast-effects do not occur except as differences of intensities. The toothache, at a given moment, may be felt more keenly than the simultaneous earache, but the toothache itself as a sensory phenomenon does not thereby diminish the effect of the earache.

Referred pains.—The internal organs appear to be relatively insensitive except as some marked derangement takes place. However, it is commonly known that disturbances of these organs evoke pains in different areas

of the body, sometimes quite remote from the point of disturbance. Digestive derangements cause headaches. Malfunctioning of the heart may appear as sensations of choking and suffocation. And other internal disturbances project their sensory effects, so to speak, at variously distant points. Accordingly, such pains are spoken of as *referred pains*. They are explained in terms of "overflow activities" of the respective neural mechanisms, the direction of the "overflow" passing from an area of relatively low sensitivity to that one of high sensitivity which is in close central (brain) connection (7).

KINESTHESIS

The kinesthetic, or *motor,* sense comprises a number of differential qualities, each of which denotes a characteristic "feel" of body movement, either of the body as a whole, as in walking, or of a movable member, arm or leg.

The kinesthetic qualities.—Introspectively, these qualities are sensed as effort, strain, friction, and, probably, fatigue. Common experience will illustrate these qualities in abundance—carrying a heavy suitcase, climbing a flight of stairs, swinging or lifting the body in gymnastic exercises, pushing a stalled automobile, and so on.

Structural features.—The stimuli which elicit these various qualities are of the nature of mechanical pressures applied in the form of muscular contraction and innervation, stretching of ligaments, and friction of joints. Receptor cells are found in muscles, tendons, and on the surface of joints. Some of these are susceptible to electrical stimulation, in which case they give rise to sensations of effort and strain, notwithstanding inhibition of actual movement. Moreover, when a blindfolded subject is anesthetized in the area of these receptors, he will

sense no movement of the particular limbs no matter in what direction they are moved.

Adaptation and contrast.—No clear evidence of either adaptation or contrast has yet been obtained. A difficulty of prime importance, here, is that fatigue quickly superinduces upon continued stimulation of the receptors.

THE VISCERAL SENSES

In the section on referred pains it was remarked that the internal organs, under conditions of normal functioning, appear insensitive. One is not aware of the continuously operating events within stomach, intestines, heart, liver, lungs, and so forth. One is quite aware, however, that "something happens" at intervals—hunger, thirst, sexual feelings, etc.—which potently affect behavior for the time being. Whether or not this "something" should be referred to as *a* visceral sense, as visceral *senses,* or whether it is explicable in terms of the senses already discovered is at present problematic. Inaccessibility of the internal organs precludes thorough experimentation. And introspective analyses prove to be vague and ambiguous.

It has been established that *hunger sensations* occur with muscular contractions of the stomach walls (8); but, as sensations, they are regarded as a blend of pressure and ache (25). *Thirst* appears to be a blend of tactual qualities (37). *Nausea* is the sensory resultant of movements of expulsion mingled with components of smell, taste, and pressure (25). *Sexual sensations* involve pressures, tickle, and kinesthetic reactions induced by tumescence of the genital organs. Yet tumescence is not an essential factor. Erotic feelings are possible at an age long before tumescence can occur and even after operative removal of the genital organs (26). Sensations of *distension,* also, seem to be blends of pressure, itch, and kinesthesis.

TABLE XXII.

Sensory experience	*Sense*	*Receptors*	*Organ*
Colors and lights	Sight	Rods, cones	Eye
Tones, noises	Hearing	Rods of Corti	Ear
Odors	Smell	Olfactory bulb	Nose
Contact, tickle, pressure, vibration?	Touch	Corpuscles of Meissner, hair bulbs	Skin
Warmth	Warmth	Corpuscles of Pacini, Ruffini	Skin
Cold	Cold	Corpuscles of Krause, Golgi-Mazzoni, Dolgiel, Ruffini	Skin
Pains	Pain	Free nerve-endings	Skin tissues
Position Rotation Balance	Static	Semicircular canal system hair cells	Ear
Effort, Strain, Movement	Motor	Organs of Pacini and Golgi	Muscles Tendons Joints
Tastes	Taste	Taste buds	Tongue
Hunger? Thirst? Nausea? Lust? Distension?	Visceral?	?	?

SUMMARY OF THE CHAPTER

We have now completed an elementary survey of the sensory-perceptual equipment of man. In this survey, psychology is seen to link with physics, chemistry, and physiology in a scientific enterprise of determining the interrelationships of stimuli, receptor-mechanisms, and organic adjustment. Many details concerning these interrelationships have yet to be ascertained. So far,

much more is known of the visual sense than of the other senses for reasons already suggested.

In the present chapter, the chief details of the senses of hearing, equilibrium, smell, taste, touch, temperature, pain, kinesthesis, and the so-called visceral senses have been presented as they pertain to the psychological problems of human behavior. In the following chapter, we shall observe how the senses interfuse in the organization of behavior as a configural whole of adjustment. Meanwhile, for the sake of convenience, the sensory data may be summarized as in Table XXII.

QUESTIONS FOR DISCUSSION

1. Define noise, tone, timbre, fundamental, and overtone.
2. What is there about a melody which, as a psychological phenomenon, supports the organismic hypothesis? How might a mechanist explain a melody?
3. Define phase difference as a condition of auditory localization.
4. Summarize the facts of auditory defects.
5. What is psychogenic deafness? How may it be accounted for?
6. What would you infer from the table on page 426?
7. Summarize the facts of equilibrium.
8. What considerations of practical value can you derive from the analyses of smell and taste?
9. Would you say that the introspective evidence is sufficient to establish a distinct sense of vibration? Why, or why not?
10. Illustrate the suggestion-effects of warmth and cold.
11. What is meant by the biological utility of pain?
12. Summarize the data on the visceral sensations.

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CHAPTER XIV

PERCEIVING AND ATTENDING

THE experimental determination of the senses has necessarily followed the procedure of analysis. On the one hand, qualitative distinctions emerge through introspective discrimination. On the other hand, sensory mechanisms stand revealed in functional relationships with stimuli and with response-quality. In some instances, notably the visceral "senses," analysis fails to penetrate beyond introspective confusion and beyond manifest physiological barriers. Nevertheless, organic adjustment goes on. And organic adjustment *seems* to express an integrative unity or wholeness. One may regard this unity as a coöperative affair of the several senses; or, one may take it to be an indissoluble whole.

Here, then, arises a problem of interpretation. Are we to infer from the disclosures of analysis that the senses relate to each other as an assemblage of organic parts so that any given experience or behavioral adjustment becomes explicable as a "putting together" analogous to the assembling of a machine? Or, does the very character of experience or behavior as a functioning whole suggest that parts (senses) emerge as analytical aspects of the whole that is itself organically prior to the parts?

These questions, now calling for consideration, will occupy the first main section of this chapter. Next will come a discussion of the factors involved in our human proclivity towards misperceptions, as in illusions and hallucinations. Finally, we shall take note of the chief characteristics of attention and concentration.

SENSORY INTEGRATION

We have already observed how introspective differentiation of sensory quality serves as a basis for classification. Sights, sounds, pains, smells, tastes, pressures, and so forth are separable phenomena, each of which is further subject to differentiation in terms of its own qualitative aspects—hues, grays, tones, etc. Thus one may define a rose, say, in terms of pinkness, whiteness, greenness, fragrance, smoothness, and prickiness.

So far, and probably farther, does analysis proceed. What now, one may ask, *is* one's perception of the rose? Is it an *accretion* of these qualitative aspects? In other words, is the perception derived by an elemental activity of adding pinkness to whiteness to greenness to fragrance to smoothness to prickiness, and so on? Or is the perception initially and originally a whole? The analysis itself does not tell us. One may, indeed, assume a synthesizing activity in the brain (mental chemistry?) but analysis could not disclose it. At all events, it is mere speculation. We had better look to another type of explanation.

Genetic integration.—William James has presented the view that an infant's first sensory impression is a sort of "big, buzzing, blooming confusion." But this view is speculative, too, inasmuch as the infant's experience must be interpreted largely, if not solely, from the standpoint of adult retrospection and reconstruction. Certainly the infant cannot describe his experiences for us. Still, psychologists of infancy and childhood are pretty well agreed that the earliest sensory experience of the individual is vague and undifferentiated. This experience, doubtless, is not even a confusion for the child; for confusion pertains to an introspective characterization of the situation present to the organism. At any rate, from carefully controlled observations of infant

behavior, psychologists conclude that sensory adjustment proceeds from the vague to the definite, from the undifferentiated to the particular.

There is no evidence to support the view that the infant's original experiences are built up of discrete sense qualities. On the contrary, both genetic psychology and logic support the view that these qualities become discrete as behavior-responses become particularized; that is, as coördination develops towards the features of the environment. And this coördination, in turn, develops in functional relationship with the child's perception of the utility of objects, utility, that is, for its own satisfactions. Thus the feeding-bottle, let us say, is not first perceived as a white-hard-slippery-warm something but as a very vaguely sensed "something" which slowly takes on meaning as a "thing-bringing-satisfaction." Eventually, this "thing" becomes identifiable as a bottle containing whitish fluid and as a "composite" of numerous qualities, all appearing as differentiations in terms of utility (6).

Furthermore, studies of adult perceptions indicate a similar process from vagueness to definiteness. This has already been described and illustrated in connection with experiments on the growth of concepts (Chapter Ten). There it was noted that the situation present to sense is always initially perceived *as a whole,* the details of which emerge as one undertakes to deal with it. These experiments confirm genetic observations, and both illustrate the essential character of the perceptual activity. As Cohen puts the matter: "In ordinary life we perceive trees before we perceive birches" (1).

The above considerations should not be taken to imply denial of the method or results of introspective analysis. Undisputably, this method has brought to light an invaluable mass of data, as the two chapters immediately preceding bear witness. It is in respect to *interpretation*

of the data that misconception arises. That a whole—perception of an orange, say—can be broken up into sensory qualities, each analytically discrete, does not warrant the inference that the whole was originally compounded of these qualities. Such an inference is indicative of a failure to recognize that wholeness is *integration,* not summation, that wholes antedate parts, and that parts are the abstract products of analysis (2, 11).

Associative organization.—All organic activity, whether in the form of a neuromuscular skill or in the form of a perceptual pattern, exemplifies organization. Adjustment to whatever situation confronts the organism is a totality. And as a totality it is capable of expansion within the limits of its structural condition. Thus the infant's adjustment-organization is relatively quite simple and vague, but its organization increases in complexity of response possibilities through maturation and by environmental stimulation. Percepts become more detailed; concepts evolve in richness; and activity enlarges in scope; all of which typify expansion of adjustment through associative integration.

In the broad sense, this has been called conditioning. We have observed it in the forms of learning, of emotive complexes, and of imaginative developments. One associates a topic with a teacher. One may feel "blue" on hearing melodies in the minor mode. And one can see topical possibilities in an old coat. The variety of associations is practically infinite; and through them all one finds and one evolves an integration of various sense qualities.

Thus architecture expresses "frozen music"; a musician's tonal effects give one the "feel" of velvet; a painter's depiction embodies "tone" and "key." Even flowers suggest music, as in the poem of Mrs. Hemans (12).

"By what strange spell
Is it that when I gaze on flowers
I dream of music? Something in their hues,
All melting into colour'd harmonies
Wafts a swift thought of interwoven chords,
Of blended singing-tones, that swell and die."

And the line by Shelley:

"Sweet as a singing rain of silver dew."

Also one from Swinburne:

"Fine honey of song-notes goldener than gold."

Synesthesia.—For some individuals sensory organization appears not to be an effect of adventitious association but rather of some inherent neurological organization. To illustrate: on stimulation of the organ of hearing a visual effect is induced as well as a tone. This is a case of "colored hearing" and is an aspect of the phenomenon called *synesthesia*. Lewes gives an account of this phenomenon as follows:

"Herr Nussbaumer and his brother from childhood upwards have always had sensations of color simultaneously excited by sensations of sound. It is not simply that sonorous vibrations excite colors accompanying the sounds, but definite sounds excite corresponding definite colors. . . . Both brothers have been accustomed to designate particular tones by their attendant colors. The shrill womanly tones of some men's voices they call yellow; the rasping voices of some others they call grayish-brown. Thus the tone of 'g' is orange for one brother, and orange-yellow passing over into cornflower blue for the other. . . . When a chord is struck, one brother has a blending of colors passing from dark to bright, and from bright to dark; the other has a vividly changing mixture with sudden flashes of particular colors. . . . When dreaming, if the brother hear a trumpet or a drum, a shriek

or other loud noise, there arise the same corresponding colors as those which arise in waking hours" (4).

In general, the same tones for different individuals do not evoke the same colors. There is a tendency, however, on the part of a given individual to exhibit consistency of tone-color associations (5). Nothing is known of the causal factors of this phenomenon. It does appear to run in families, thus indicating a congenital origin (9).

ILLUSION

Despite the common contention that "seeing is believing," we learn in experience not to believe everything we see; for if we did so believe, we would quickly become enmeshed in contradiction and confusion. Perceptual errors, no matter what the sensory avenue, are notoriously ubiquitous. The stick which appears bent when partly submerged in water typifies the innumerable instances of our inability to perceive things as they really are. To recognize this inability, and to make proper allowance therefor through knowledge of the conditioning factors, make for more effective adjustments in daily life.

No one appreciates more vividly the deceptiveness of the senses than does the aviator. The circumstantial hazards of flying in heavier-than-air machines are relatively so great that a pilot's misperceptions are fraught with greater consequences for life and limb than is the case in other instances of human enterprise. Kingsford-Smith calls attention to this in the statement: "A pilot flying blind must have immense faith in his instruments. He must train himself to realize that if the barometer of his senses disagrees with the instruments they are right and his senses are wrong" (3).

The senses are often wrong because one's *interpretation* of their "reports" represents an intermingling of the

present data of the senses with the memory-images of past experience together with the effects both of training and of the deficiencies of the sense mechanisms themselves. This intermingling, as a condition of perception

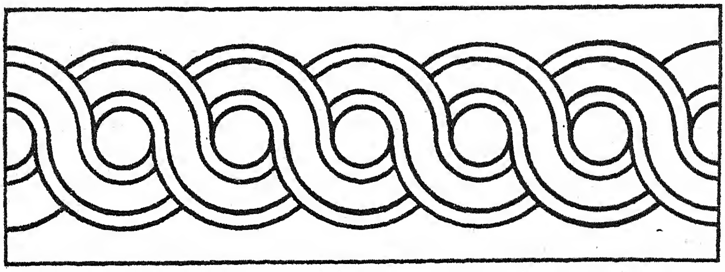


FIG. 60

and interpretation, may best be illustrated under three types of influence.

The influence of habit.—A familiar instance of habit may be noted in the "proofreader's illusion." No matter how thoroughly trained one may be in accuracy of spelling, for example, one still occasionally overlooks

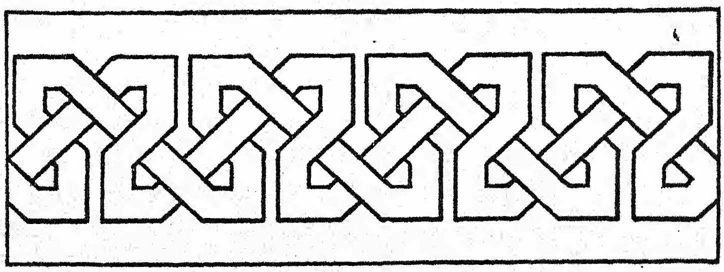


FIG. 61

errors. Here the illusion is attributable to the greater dominance of the habit of noting *meanings* of words than of *structures* of words. Hence one is likely to miss transpositions of letters—preception, recieve—as well as omissions of letters—varous, guarntee.

Habit determines one's orientation to situations and is thus responsible both for oversights and additions of details in a given situation. Figures 60-63 illustrate typical effects. Lines are seen as though they interlaced rather than terminated. Incomplete figures are seen as complete.

FIG. 62

The influence of expectancy or set.—Closely related to, and in fact overlapping, habit is one's attitude of expectancy—sometimes called "set." It may be quite temporary or it may be relatively permanent.

FIG. 63

In illustration of the influence of *temporary set,* one may mention the emotionalized "atmosphere" of certain types of religious ceremony where, under the influence of prayers, exhortations, and reverential stillness, the worshipers "see" and "hear" the Virgin or the Deity. Again, the spiritualistic seance is notoriously charged with illusory effects whereby those persons who attend with uncritical attitudes are spontaneously induced to accept as bona fide the alleged demonstrations of communication with deceased persons. And in this connection, one may recall numerous instances of "stunts" performed by theatrical magicians who depend quite largely for their success upon the attitudes of expectancy on the part of the audience.

Other, and perhaps more frequent, examples of temporary set will be recognized in the tendencies to misconstrue the objects and events of the environment. The woman who goes out at night unescorted may interpret a dimly-perceived post to be a man lurking in the darkness. One's eagerness to recover health may evoke an illusory conviction regarding the efficacy of pills and

potions. And one's concern for the arrival of a friend may make the minutes seem twice or thrice as long as they actually are.

In illustration of *permanent set,* one may refer to the illusions of size and weight of objects. The common expectation that the larger an object is the heavier it is likely to be typifies a frequent cause of misperception. Commercial enterprise often capitalizes upon this attitude by suggesting to the consumer through size and coloring of package that he is getting a lot for his money. And from the realm of preconceptions, as in prejudices and beliefs engendered through training, innumerable illustrations come to mind to support the aphorism: "One sees what one looks for."

The influence of configuration of stimuli.—Perhaps no more striking instances of misperception are found

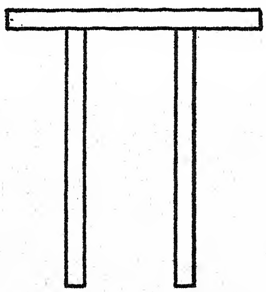


Fig. 64

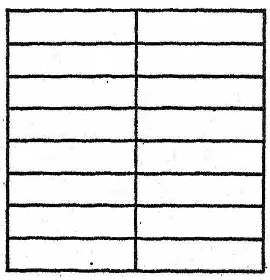


Fig. 65

than those of geometrical designs, visual perspectives, and other configurations of line and color arrangements. A familiar principle of dress designing is to adapt line arrangement to the particular figure to be draped. Thus may a tall person appear shorter than he really is, a short person taller.

A vertical line equal in length to a horizontal will appear longer (Figs. 64 and 65). Filled areas appear larger than unfilled areas (Figs. 66 and 67).

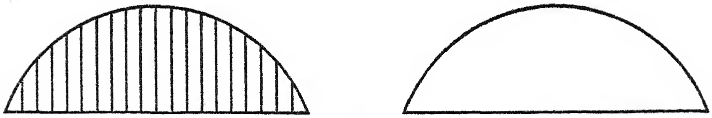


FIG. 66

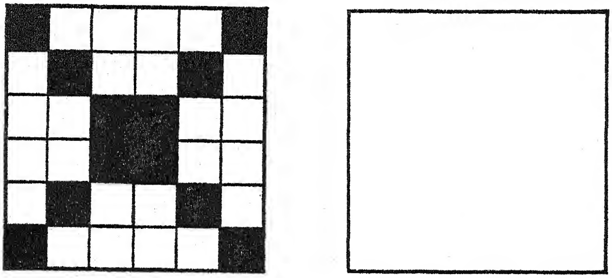


FIG. 67

Areas of equal magnitude appear unequal when surrounded by contrasting areas (Figs. 68 and 69).

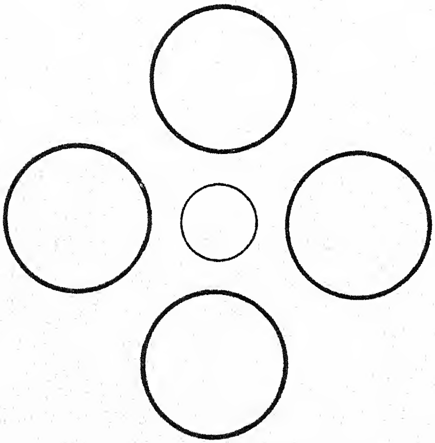


FIG. 68

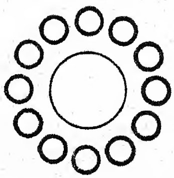


FIG. 69

Illusions of the third dimension are induced by line arrangements and also by shading (Figs. 70, 71, 72).

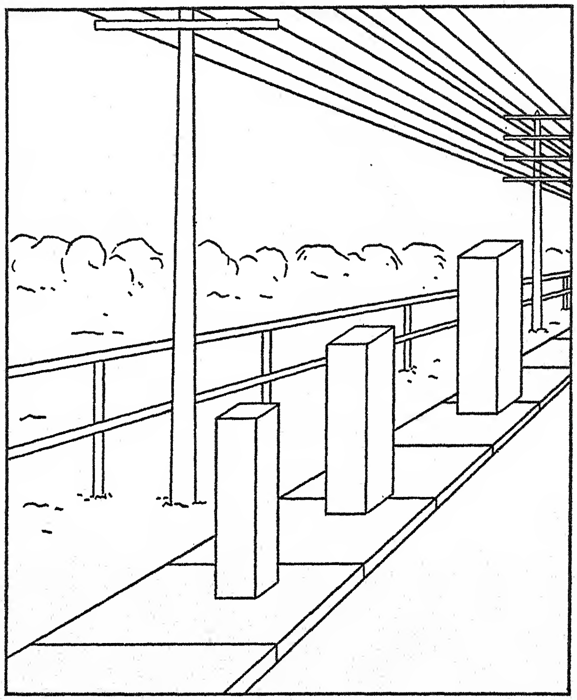


Fig. 70

Angular degree affects the appearance of lines which physically are equal (Figs. 73, 74, 75).

Numerous configurations of stimuli present *ambiguous* percepts. Some are of a reversible character (Figs. 76, 77, 78); others portray a design upon a ground (Fig. 79).

A striking illusion is that of the "floating finger" (7). To obtain this effect one should hold the two hands before the eyes, palms inward, and index fingers touching tip to tip, as in Figure 80 *A*. Then, as one fixates a more distant point, with the line of vision passing just above

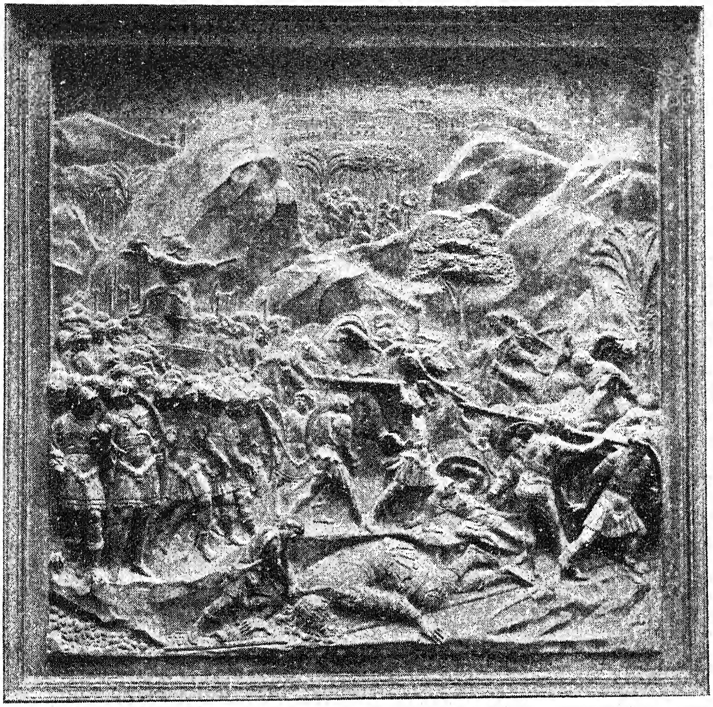


Fig. 71
David and Goliath (Ninth Panel), East Doors, Baptistery, Florence. (Courtesy of The University Prints)

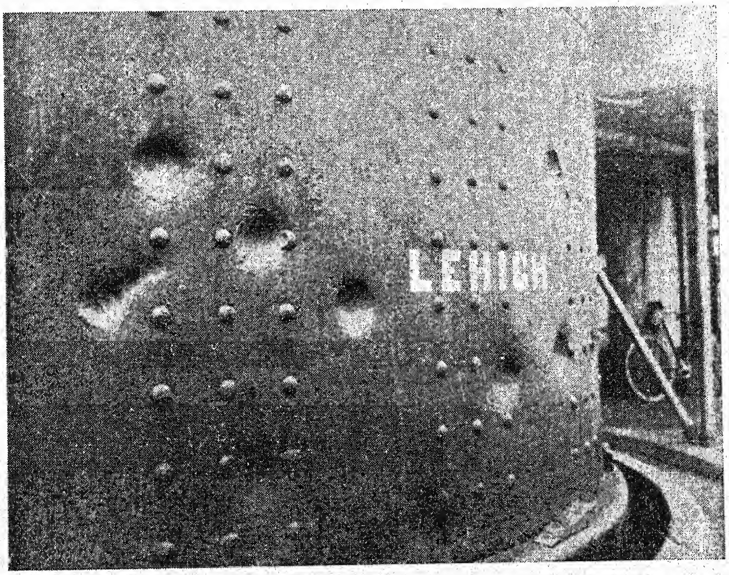


Fig. 72
A striking effect of shading. Note the change on turning the figure upside down. (Courtesy of C. H. Stoelting)

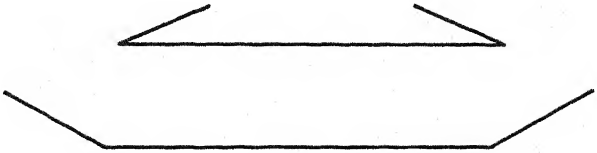


Fig. 73

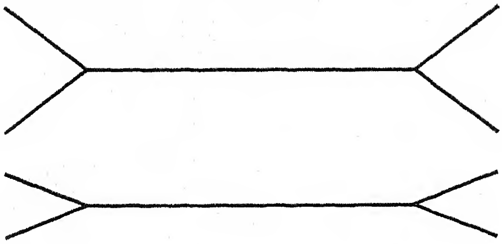


Fig. 74

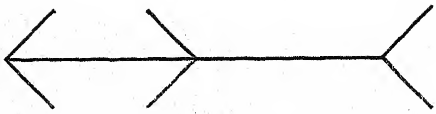


Fig. 75
Müller-Lyer

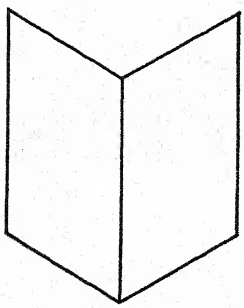


Fig. 76

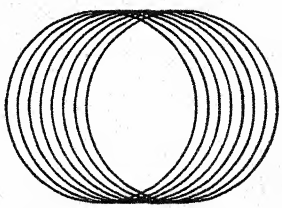


Fig. 77

the point of finger contact, one should see an oval segment of flesh being supported, as it were, by the two fingers (Fig. 80 *B*). The floating effect appears when one

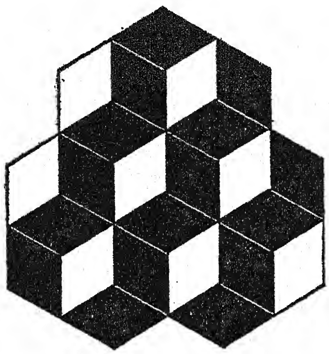


FIG. 78

draws the fingers slightly apart. Moreover, an interesting tactual illusion can be obtained by slightly rubbing the finger tips in an up and down motion.

For other senses, illusions are not nearly as common as for vision, hearing, and touch. This circumstance pre-

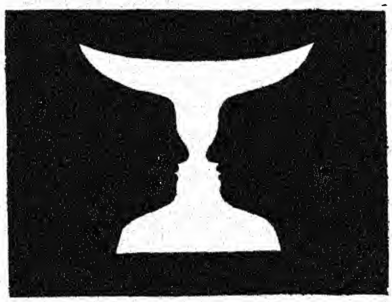
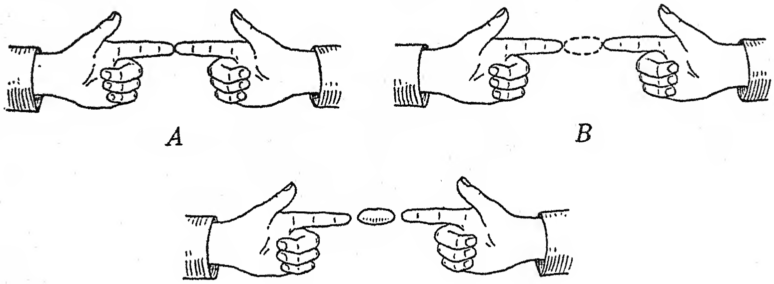


FIG. 79
(Rubin's figure, from Wheeler)

sumably reflects the importance of these three senses in our everyday orientations to objects and situations of the environment; for we tend to ignore, for the most

part, the rôle of the other senses—kinesthesis, equilibrium, warmth, cold, etc. Nonetheless, on occasion these do exhibit illusory features. And practically every sensory situation, as one's experiences develop from infancy on, becomes a fertile field for suggestion-effects.



A B

C

FIG. 80

Theoretical considerations.—All the foregoing examples of illusions have been interpreted in terms of conditioning factors—habit, expectancy, configurations of stimuli. These factors, to be sure, overlap; but they give no indications of the correlative physiological factors involved. Hence the problem remains as to the relationships between the character of the stimuli and the brain mechanisms, on the one hand, and between stimuli and individual training-effects, on the other.

In the first place, we may assume an inability on the part of the brain to deal with a configuration of stimuli in terms of separable components. One cannot do other than see the partly submerged stick *as bent*. One cannot avoid tendencies to follow lines of direction in a pattern and thus cannot escape seeing equal dimensions as unequal. One cannot help but misconstrue directions of sound when the point of origin and the intensity are equalized for both ears. As an integrative mechanism, the brain must accept the sensory data. The distortion, then, must be referred to the sense mechanisms them-

selves; that is, to terms of specific relationships between stimuli components and receptor structures. What these relationships are remains a problem for interdependent research by physics, physiological chemistry, anatomy, and psychology.

In the second place, brain responses are suffused with effects of training. Through myriad experiences in adjusting to the features of our environments we select certain features as cues of understanding and we employ these cues whenever we find ourselves confronted by situations of similarity. We learn that large things are heavy, that wetness is shiny, that sounds become fainter as they recede farther, and so on. Accordingly, we are apt to overestimate the effort required to lift a large-appearing object; we are likely to be deceived in supposing that the shiny road ahead is wet, and that the faintly sounding auto horn means that the car is farther from the crossing than it really is.

The problem, therefore, of determining the precise causal factors in illusory perception is an extremely complicated one. Certainly, little progress has been made toward the solution of this problem. Indeed, it may turn out an insoluble one for the reason that no human technique can be devised to unravel the differential effects of sensory stimulation, cerebral response, and cumulative experience. Then, too, the problem as stated may involve highly specious presuppositions, namely, that its approach should be atomistic and that a qualitative whole—the perception as a meaningful experience—is ultimately explicable in quantitative terms.

This consideration is one of great importance. The fact that one *recognizes* a given perception *as illusory,* that one can *realize* the *unreliability* of the senses, lends support to the hypothesis that perception is no mere accretion of structural details but involves a wholeness of reaction that is discriminatory and insightful. One

scrutinizes the sensory data and finds them wanting. And one finds them wanting only by reference to a standard of judgment which itself cannot be reduced to those data. For the individual stands outside the data, so to speak, and evaluates them, not alone by reference to the immediate situation but also to his own past experiences.

HALLUCINATION

It has been customary to differentiate hallucination from illusion both as to stimulus-pattern and ensuing behavior. In illusion, a sense object is involved; in hallucination, a sense object may not be present at all, that is, as a determinant factor. Hallucinations are somewhat akin to dreams in so far as they denote "projections" of imagined persons and objects; yet they differ from dreams inasmuch as the victim reacts to the imagined features as realities. Whatever objects are present to the victim, they will either be ignored by him or be incorporated in the imaginative pattern.

Organic conditions.—Many instances of hallucination may be traced to a disturbed condition of the brain. This condition can be brought about by intake of alcohol and other toxic agents, by pressure upon the brain by a tumor, and by fever. The well-known hallucinatory accompaniment of delirium tremens, in which the victim "sees" and "hears" all sorts of terrifying situations, may be mentioned only in passing. Recovery from the alcoholic spree, from the effects of drugs, and from fever, occasions the subsidence of the hallucinations. In cases of brain tumor, for which hallucinations are often symptomatic, the question of recovery is one of operative accessibility.

Psychological conditions.—Hallucinations are also symptomatic of insanity. In fact, for many cases of insanity hallucinations are the dominating circumstance

of their daily lives. Patients walk up and down the corridors of asylums fruitlessly endeavoring to shut out persecutory "voices" and to avoid imaginary objects and persons. To these patients, of course, the objects, persons, and voices are anything but imaginary; on the contrary, they are so real as to make life altogether miserable.

Numerous cases of hallucination among the insane come under the classification of organic conditions—the alcoholics and the drug addicts. Others appear to have no organic malady of any sort whatsoever. Yet these suffer no less acutely from their hallucinatory experiences than do the victims of organic disorder. Even if it be granted that psychological conditions such as emotional imbalance and anomaly of character development provide a sufficient explanation of these cases, one should not thereby assume that the hallucinatory concomitants are unreal.

On the border line of sanity and insanity are the psychopaths. These are the "queer" individuals; often intensely religious and convinced that they are "inspired" with a message for mankind. Some of them claim to have "visions." Some claim to have been "authorized" or "commanded" by the Deity to perform definite services. Perhaps in no other circumstance of their behavior do they express the earmarks of the insane. Nevertheless, their deadly earnestness, their willingness to endure indignities and even martyrdom, and their seeming immunity to contradictory evidences are diagnostic signs of psychopathic personality.

Undoubtedly, an extraordinarily intense religious fervor inculcated in an individual of extreme susceptibility would lead him or her to spend a great deal of time in meditative devotion wherein imagination may break the bounds of logic and factual necessity and develop to a degree of vividness indistinguishable from reality. And

from meditation to action is a simple and obvious step for a person lacking the restraint of critical inclination. Out of beliefs rooted deep in emotion it is not difficult to generate the self-flattering conviction that one is inspired or that one is a special messenger of the truth. As a matter of fact, the asylums provide numerous examples of this type of conviction.

Psychiatric observation of both psychotic and psychopathic cases of hallucination lead to the view that such cases have at the core of their personalities, so to speak, a galling feeling of inferiority which they endeavor to compensate by imaginary notions of superiority. If this view is correct, and there are adequate grounds for believing it to be so, then one may understand why the compensatory motive goes to the limit in establishing the individual as a unique object of Providential solicitude. Here, indeed, are security, requited devotion, and self-evaluation.

ATTENDING

The very act of attending is none other than the act of perceiving. Both terms synonymously refer to that coördinate activity of the organism in sensorially fixating some object or situation in the immediate environment. Under the topic of illusion this activity has been denoted *set* or *attitude*. Commonly, one means by attending a highly intense form of perceiving for which the term *concentration* is particularly appropriate.

To concentrate, then, is to organize the factors of behavior so as to effect the clearest possible adjustment toward the object or problem at hand. It is essentially a *selective* process, for one obviously cannot respond to all the stimuli which constantly impinge upon one's receptor mechanisms. This selective character of attending appears objectively in outward posture. A cat, watching a mouse, exemplifies a striking instance of

attentive behavior. Its body posture is that of crouching close to the ground; its head is held rigidly forward; its eyes intently pursue the moving creature; and it tends to resist distraction. Comparable illustrations from human behavior readily occur to one.

Subjectively, one is dominated, as it were, by the particular object or problem. At the moment one does not reflect that this is so; if one did so reflect, the attention would thereby lapse. Yet, on retrospection, one may recall sensations of muscular tenseness in the eyes, the head and neck; and in other parts of the body. All this tenseness of posture can be understood only as functionally related to some goal which, whether in the form of some sensory object or the solution of an abstract problem, focalizes the activity of the individual.

Perceptual discrimination.—All perception, we have seen, involves discrimination. We are constantly comparing, estimating, judging. We say this room looks brighter than the one we just left; or this motor sounds noisier than it did when we started on the trip; or this suitcase in the right hand feels heavier than the one in the left. And although the objects or situations being judged are physically equal, one's psychological estimates of them, as we know, are subject to more or less gross errors.

Psychologists have performed a great many experiments on this phase of attending, and the results have been formulated in a law called the *Weber-Fechner Law of Just Noticeable Differences,* after two of the pioneer workers in the field of sensory discrimination. This law expresses a mathematical relationship between the least noticeable sensory increment and physical increments; that is, *"The intensity of a sensation is measurable in terms of the logarithm of the intensity of the stimulus."*

The application of this law appears to be restricted to the middle range of sensory stimulation and also to a

limited number of senses. Table XXIII gives the just noticeable difference values for the senses amenable to measurement.

TABLE XXIII.

Sense Quality	*Intensity Ratio*
Visual (light)	0.01
Hearing (tones)	0.15
Hearing (noise)	0.33½
Smell	0.25
Taste	0.25
Pressure	0.05
Warmth	0.036
Cold	0.036
Kinesthesis	0.025

Many situations of daily life call for practical application of the Weber-Fechner law. The table above gives the precise increment-values required for purposes of determining a just noticeable increase in sensitivity. Thus an extra weight of one pound added to a suitcase already weighing forty-five pounds would not appreciably increase the "feel" of the total weight. Adding one candle to a light of fifty candle-power would make a considerable difference to vision but no difference at all if added to a light of one thousand candle-power.

Reaction time.—In its simplest form, the attentive process may be observed in the reaction-time experiments. Here the conditions of attention are rigidly controlled, the subject being required to respond, for example, by pressing a telegraph key on stimulation by a light or sound. By means of electric timing devices, the period between reception of the stimulus and execution of the response can be measured in thousandths of a second (.001 second = 1 sigma).

Two forms of reaction time are specified: *sensory* and *motor*. In the former, the subject is required to attend to the *stimulus;* in the latter, to the *response*. On the average, when the subject attends to the response, his

reaction-time is shorter than when he attends to the stimulus. Table XXIV gives typical values.

TABLE XXIV.—Reaction Times.

Stimulus	*Sensory attention* (sigma)	*Motor attention* (sigma)
Light	290	180
Sound	225	120
Electric (skin)	210	105

Reaction time, needless to say, is a crucial psychological factor in many of the circumstances of daily life: the motorman or engineer in applying his brakes on perception of an object or person suddenly appearing on the tracks; the electric switchboard operator's response to signals; the machine-operator's detection of a portentous click; the sprinter's alertness for the starting gun; and the autoist's manipulation of clutch and acceleration of engine upon change of traffic light from red to green.

The conditions of attention.—In the descriptions and illustrations of the attentive process thus far given, one condition appears in the form of goal relationship. This condition, however, pertains primarily to *voluntary* attending; as such, it denotes a patently purposive focusing of behavior upon a situation or problem. It is this focusing which we designate concentration.

In contrast to goal-attending is the distracting or *involuntary* type. This type is familiarly expressed in the phrase, "arresting" one's attention. Numerous conditions determine this type of attention, of which the following are the more common. In the case of each, one must take into account the qualification, "other things being equal," for no one operates in isolation.

Intensity of the sensory impression.—The brightest light, the loudest sound, the most obtrusive odor, the sharpest taste, focus attention so effectively that other

features of the environment become momentarily obscured.

Size of the sensory impression.—Ordinarily, in a group of persons the largest individual is noted first of all. In a newspaper page of advertisements, the one having the largest type or figure will command initial attention.

Quality of the sensory impression.—For the musical ear, a note sounded off pitch will tend to sharpen perception. A hat or coat of vivid hue, particularly red, orange, and yellow, stands out above all other hues.

Sudden change of sensory impression.—The ringing telephone diverts one's direction of interest. An orchestra's abrupt change of rhythm will evoke disturbance and expressions of surprise upon the part of dancers.

Sudden cessation of sensory impression.—One may not notice the tick of the clock or the hum of the refrigerator as one reads a book or studies some problem; but as soon as the tick or hum ceases, one's attention becomes focused, so to speak, on the fact of cessation.

Repetition of sensory impression.—The advertisement which has passed unnoticed on several occasions eventually obtrudes itself upon one's vision. This condition, however, may operate adversely, too, as is well recognized in the expression, "Repetition dulls the senses." Consequently, psychologists have discovered through experiment that effectiveness of repetition depends upon time-interval of appearance (8).

Movement of sensory impression.—From the field of advertising, again, the "moving" electric sign is a familiar but potent arrestor of attention. Moreover, an object that is within the periphery of vision at the moment may not be noticed until it begins to flutter or move away.

Novelty of the sensory impression.—An occasional italicized word or phrase on the printed page will focus and intensify perception. A horse and buggy traveling

down the main thoroughfare of a city will nowadays arrest the attention of the people on the street. And in a church, the appearance of a person dressed in pyjamas or in a bathing suit would disrupt the attentiveness of the most devout worshiper.

Congruence of sensory impression with present "set."—The anxious mother will catch the slightest whimper of her child but may not hear the rumbling train on a nearby track. The pilot of an airplane will detect something wrong with the motor and bring the plane to a safe landing while the passengers have sensed nothing out of the ordinary. Specialization of training, of course, always effects a specialization of perceptual orientation.

Organization of the stimulus pattern.—By organization, here, is meant the meaningfulness of the situation to the particular individual. Aside from congruence with present "set" or interest—which also involves meaningfulness—one is more likely to attend to that complex of sensory impression which one readily grasps. In musical performances, for example, many persons fail to attend to, and therefore fail to appreciate, the classic forms (and even some modernistic forms) of symphonic composition because the thematic structure is too complex for them. Quite different is the case of simple melodies. Similarly in a lecture, sermon, or even conversation, the features most easily grasped and subsequently recalled are the stories and illustrations; for these almost invariably focalize attention, chiefly by virtue of their meaningfulness for one's own experiences.

Range or span of attention.—The condition of organization just mentioned evokes the question as to how many items one can grasp in the act of attending. Upon this question two experimental procedures have been brought to bear: (*a*) *simultaneous presentation of a number of discrete items,* (*b*) *successive presentation of*

discrete items. Both procedures utilize letters, words, digits, and sounds, for the most part.

Results with both procedures indicate quite uniformly that one can attend to a maximum of *six* items, a circumstance which, according to Titchener, "agrees very well with the canons of musical and poetical practice" (10). These results, however, pertain to materials of homogeneous character. When heterogeneous materials are used, experiments show that only *one* item can be attended to *at once.*

There are persons, to be sure, who claim a capacity to attend simultaneously to heterogeneous items. Very probably such persons alternate or oscillate their foci of attention so rapidly that the disparate items appear simultaneously grasped. In some cases, automaticity of habit is the explanation. To illustrate: one may converse with an organist while he plays a well-practiced composition, even though the playing involves the complicated activity of fingering the keys, changing the registration, controlling the swells, and manipulating the pedals. Similarly, one may add a column of figures while reciting a poem, but only if the latter has been well learned.

The problem of distraction and concentration.—For practical purposes, this problem ties up not only with the goal and other conditions but also with organic conditions. Even the most zealous and conscientious student finds it impossible to maintain a consistently high level of concentration for more than a few seconds at a time. If he is reading, vision fluctuates, attention relaxes. He catches himself, as it were, and refocuses his attention. No matter what sensory channel one for the moment concentrates through, one experiences ups and downs of the attentive attitude. It is as if the stimulus—visual, auditory, olfactory, tactile—comes and goes with perhaps a rhythmic regularity.

Experimentally, one may test this phenomenon of sensory fluctuation by means of a reversible perspective design such as was illustrated in the section on illusions. As one fixates the figure, it will fluctuate rather rapidly at first until, after considerable practice, one seems to gain control over the fluctuations, at least to effect reduction of their frequency.

Practically nothing is known of the underlying conditions of this phenomenon. It may be due to conditions within the receptor cells, possibly of the nature of chemical instability. It may be due to neurological factors within the brain and its connections with the sense mechanisms. At all events, it is a phenomenon relatively independent of the goal of attention and of the involuntary conditions previously enumerated, yet, withal, interdependent.

Distractibility, otherwise, is functionally related to goal activity. The so-called absent-minded individual is intensely "minded." He is so preoccupied with his goal that other aspects of his immediate environment do not enter into his perceptual configuration. His eyes appear to transfix the sidewalk as he walks along but he does not see the open manhole until the unexpected descent suddenly changes the focus of attention.

Excluding pathological cases, there is no such thing as inability to concentrate. We are not here concerned, of course, with organic conditions of fluctuation as illustrated above. One concentrates or does not concentrate in terms of interest for the immediate task in hand. The child who fails to attend to his arithmetic may be most attentive to the details of a game on the playground. The student who cannot concentrate on the literature or history assignment should examine his interest. If this is lacking, conscious effort may be futile. The thing to do is to seek some associative link with one's dominant goal and concentration may be left to take care of itself.

Can one be trained to observe?—In view of the foregoing considerations, the question of training to observe should take the form of development of interests. Yet it is frequently claimed, both by quacks and pedagogues, that the employment of special techniques will effect improvement in ability to observe and to concentrate. These techniques reflect a belief in transfer values. Disregarding the claims of quack-vendors of "training systems" we may look to the claims advanced in behalf of certain curricular subjects as special devices for cultivating attention. Laboratory science, mathematics, and languages have variously been endowed with magic potency for effecting improvement in concentration inasmuch as the study of these demands careful observation of details for successful mastery. Yet the evidence is lacking. Transfer effects, as we saw in the chapter on "How to Learn Effectively," cannot be guaranteed as a matter of course.

All the data from psychological studies and experiments point to one conclusion, namely, that observation and concentration are aspects of insightful, configural organization of perceptual data under the dominance of goals or interests. But aside from experiments, even the common observations of vocational and avocational activities point to the same conclusion. The physician notes details of diagnostic signs which the layman misses altogether. The geologist tramps through the countryside and sees a myriad things of interest which to the average person are nonexistent. Even a boy scout may confound the uninitiated by his demonstration of observational keenness simply because nature study is an integral part of his activity program. And so the illustrations could be multiplied indefinitely.

Thus one may conclude that interest will take care of concentration. Here, to be sure, is a simple technique,

so simple, indeed, that one is likely to overlook it in the vague search for something magical or erudite.

SUMMARY OF THE CHAPTER

The apparent discreteness of sensory impressions, as indicated by introspective analysis, called for interpretation as to whether sensory experience is a composite of elemental bits or whether it is of the nature of a totality to begin with. From studies of genetic development the conclusion appears warranted that the earliest experiences of the individual are essentially vague and undifferentiated and that, as development proceeds, vagueness gives place to definiteness in the form of discrimination of sensory details of the environment. Indeed, whether one considers the perceptual activity of a child or that of an adult, the procedure is always from the general to the particular, from the whole to the parts.

In everyday life, sensory differentiation and organization is occurring all the time. Associative patterns of sensory qualities develop by expansion rather than by accretion.

But whatever the sensory data, they are subject to misinterpretation. Habit, expectancy, and configural arrangement evoke illusions. Organic disturbances and peculiar psychological conditions induce hallucinations. The former (illusions) are characteristic of normal experience; the latter (hallucinations) are symptomatic of personality distortion.

The process of attending is defined as a restricted or focalized activity of perceiving. Experimentally, this process may be investigated as the discrimination of just noticeable differences and also as reaction time. The conditions of attending, aside from dominance of purpose, are intensity, size, quality, sudden change, sudden cessation, repetition, movement, novelty, congruence, and organization of sensory impressions. Range or span of

attention is limited to six items in the case of a homogeneous grouping, and to but one item in a heterogeneous grouping.

Concentration is largely a matter of dominance of interest. Accordingly, training in concentration should take the form of cultivating interests.

QUESTIONS FOR DISCUSSION

1. What, in your own words, is the problem of sensory integration?
2. How does utility relate to perceptual discrimination?
3. Cite examples of associative integration from your own experience. How might they illustrate creative imagination?
4. Would you say that the poetical citations in this chapter are cases of synesthesia? Why, or why not?
5. Give your own illustrations of illusory perceptions. How would you account for them?
6. Considering the subtlety of numerous conditions of illusion, would you say that one could train oneself to be immune to such conditions? Why, or why not?
7. Recall from your own experience instances of suggestion-effects. What conditions underlie these effects?
8. How might a mechanistic hypothesis explain illusion?
9. What are some diagnostic signs of a psychopathic personality? Why are these signs diagnostic?
10. How may one know that a given case of "visions" is a case of hallucination?
11. To what practical use may the Weber-Fechner law be put?
12. Give your own illustrations of reaction-time situations.
13. Give your own illustrations of the conditions of attention.
14. Would you agree that there is no such thing as inability to concentrate? Give reasons for your position on this question.

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PART VI

THE PSYCHOLOGY OF PERSONALITY

CHAPTER XV

PERSONALITY

THROUGHOUT this introductory survey of psychology, frequent use has been made of such concepts as human nature, the organism, and the individual, to the neglect of the concept of personality. Only in the discussions of emotion did this concept come to the fore. There it denoted the attainment of behavioral integration upon the plane of emotional balance. So to connect personality with emotion is undoubtedly of prime importance; at the same time, personality should be conceived as a term of more comprehensive meaning.

On the one hand, personality may be envisaged as the *functioning totality* of an organized structure whose aspects are describable in terms of skills, aptitudes, intelligence, thinking, imagining, and perceiving, as well as of feeling and emotion. On the other hand, it may be taken as a *self-conscious unity,* generated from biological conditions, and evolving and expanding under social stimulation.

Viewed as a field of scientific inquiry, personality presents a vast, practically uncharted, area. To be sure, the aspects of personality mentioned above have yielded, under experimental study, a noteworthy body of explicative and serviceable data. These data, however, have been thus far construed as behavioral segments, so to speak, rather than as distinctive patternings of functioning totalities called personalities. One may grant the convenience, for psychological study, of viewing behavior in segments; but one must ever recall that behavior in

any of its particular phases is always a dynamic wholeness. And it is this wholeness which we express as individuality and personality.

This chapter will survey the field of personality as a problem of individual patterns of behavior. It is a problem upon which psychologists have but recently focused their science and which, therefore, is still in a state of uncertainty. Yet, notwithstanding this uncertainty, the pathway towards the solution of the problem has been surveyed; a significant area has been staked out; and tools of statistical method have been found practicable.

THE PROBLEM OF DEFINITION

Personality, individuality, and selfhood are terms commonly used more or less synonymously. For purposes of psychological description, however, they are not precisely interchangeable.

Individuality denotes the biological organism as an entity separable from other, but similar, organisms. Here is one's body, spatially separable from, yet in contact with, its environment at its own periphery or outer skin. It is thus discrete both from other organisms and from the world of physical objects. As a human body, the organism is identifiable both in terms of uniformity of structure and of differences of structure; on the one hand by skeletal frame and fleshy contour, and on the other hand by complexion, weight, tallness, voice, distinctive markings, sex, and so on.

Personality pertains to a unity which, involving individuality, derives its significance from the social order. It expresses the individual's acquisition of a variety of traits the reality of which is a function of social interplay between and among individuals. Accordingly, an infant begins life as an individual; it *becomes* a person through social conditioning. In other words, personality denotes one's socially characteristic ways of adjusting.

Selfhood comprises those traits which one acknowledges to be one's own. They may or may not be identified as the traits of one's personality; for the latter are ascribed to one by one's fellows. The possessives *my, mine* express selfhood: *my* thoughts, *my* feelings, *my* attitudes, and so forth. Curiously enough, this selfhood includes an inner and an outer aspect. Sounds, for example, are thought of as "out there" while feelings are thought of as "inside" the organism. But even feelings, thoughts, experiences and the like may also be projected out of the self, as exemplified in the reflection, "My feelings overwhelm me." In fact, the one aspect of selfhood which cannot be projected is the very act itself of projecting; this for ever eludes observation; hence it can only be postulated and then taken for granted.

WAYS OF ESTIMATING PERSONALITY

Our concern in this chapter is with personality. Defined as an organization of traits which evolve from interaction of the individual and his social environment, personality manifests itself as individual modes of adjustment. To determine these modes, psychologists have devised scales and inventories the contents of which relate to those factors of adjustment usually called traits.

What are traits?—In speaking of traits, there is danger of implying something static or something amenable to pigeon-hole methods of classification. The word trait itself suggests a fixity of behavior, often as a synonym for habit. To be sure, one does develop habits as relatively stable modes of behavior, modes which provide the basis from which one's associates may fairly well predict what one is most likely to do under specified conditions. Yet it cannot be unqualifiedly maintained that habits are irrevocably fixed modes of behavior. For one thing, experimental evidence is against such a view. For another thing, practical life—in politics, religion, educa-

tion, and other schemes of reform—demonstrates the mutability of habit.

In a paragraph above, the word trait was used to signify a mode of adjustment to social circumstances. This is the meaning of trait as an aspect of personality. We should think of it not as a something innate or "inside" but as a relationship. Thus *tact, honesty, refinement, originality,* and the like are meaningful only as social relationships. It may be questioned whether Robinson Crusoe, living in utter isolation from other human beings, could express traits and hence could have a personality. Certainly, when Man Friday appears on the scene, traits emerge.

Furthermore, traits are not *units* of personality, *measurable* by some fixed standard comparable to measures of height and weight. Traits are not measurable because they are not quantities. Of course, in everyday speech one implies quantity, as in judging a certain individual to have "very little," or a "great deal" of tact or courage or originality. But one should remember that quantity here is purely figurative, despite the fact that some rating scales do imply quantity—for example, percentage of this or that trait.

As relationships, traits are found to vary from situation to situation. One may be generous towards the members of one's family and be stingy towards the church and to relief agencies. One may be coöperative as a member of an athletic team but not as a member of a fraternity. All this appears obvious enough when reflected upon. What, then, is the legitimacy of conceiving personality as a pattern of traits? For an answer, we must ascertain the methods and results of psychological investigation.

Rating scales.—In the study of personality, the construction and use of rating scales has become one of the major experimental programs of present-day psychology.

Already these scales have proved to be of immense practical value, as attested by their use in personnel organizations, in industry, in school, in civil service, and in numerous other agencies where estimates of personalities are needed for employment, for promotion, or for counselling.

They may be constructed for purposes of self-rating or for rating an acquaintance. In any case, a particular scale must express a specific objective. For example, a scale devised and standardized for rating prospective fraternity pledges would be formulated quite differently from one whose objective was the promotion of employees in a factory.

Various forms of scales have been evolved. One is the *Yes-No* form in which a list of appropriate trait terms is drawn up, the rater to underline *Yes* or *No* for each trait according as it pertains to the particular individual under consideration. A variant of this form employs the question mark (?), the underlining of which would signify uncertainty or inapplicability. Another form is known as the "Multiple-Grade Scale." In this, one finds the trait terms scorable according to the familiar academic grades (A,B,C,D,E), or to the adjectives *Excellent, Good, Average, Poor, Very Poor,* or to the numbers 1,2,3,4,5.

The most satisfactory form yet developed is the "Graphic Rating Scale." This provides for adequate differentiation by employing *behavior-grams* rather than single trait-terms. The sample on page 468 is from the *American Council on Education Personality-Rating Scale.*

The superiority of this type of scale to those mentioned above is apparent from the fact that it focuses the attention of the rater upon actual behavior situations. As a result the judgments are likely to be far more accurate than is the case when abstract terms are used. Terms such as honesty, coöperativeness, initiative, and

						No opportunity to observe
How does his appearance and manner affect others?	Avoided by others	Tolerated by others	Unnoticed by others	Well liked by others	Sought by others	——
Does he need constant prodding or does he go ahead with his work without being told?	Needs much prodding in doing ordinary assignments	Needs occasional prodding	Does ordinary assignments of his own accord	Completes suggested supplementary work	Seeks and sets for himself additional tasks	——
Does he get others to do what he wishes?	Probably unable to lead his fellows	Satisfied to have others take lead	Sometimes leads in minor affairs	Sometimes leads in important affairs	Displays marked ability to lead his fellows; makes things go	——
How does he control his emotions?	Too easily moved to anger or fits of depression, etc.	Tends to be over emotional	Usually well balanced	Well balanced	Unusual balance of responsiveness and control	——
	Unresponsive, apathetic	Tends to be unresponsive				
Has he a program with definite purposes in terms of which he distributes his time and energy?	Aimless trifler	Aims just to "get by"	Has vaguely formed objectives	Directs energies effectively with fairly definite program	Engrossed in realizing well formulated objectives	——

so on are notoriously susceptible to ambiguity of interpretation, so that no two judges are likely to have in mind any equivalence of meaning. Moreover, the graphic scale contains less suggestion of specious gradation such as academic and other "grades" imply.

Reliability and validity of rating scales.—In general, rating scales have not approached intelligence tests on the score of reliability. One reason for this is to be sought in the subjective character of ratings. Raters tend to place their friends too high on traits usually regarded as desirable and not low enough on traits usually considered undesirable. The same is true of self-ratings. Moreover, raters are prone to be influenced by a "halo"; that is, the "general reputation" which a subject is known to bear in a group or community "colors" the judgments of the rater, often in a very subtle manner.

Fortunately, the coefficients of reliability can be significantly raised when due care is exercised by the raters and when certain principles in the construction of scales are scrupulously followed. *First,* the use of behavior-grams rather than abstract terms renders judgments more dependable, as noted above. *Second,* the list of behavior-grams should not exceed ten. *Third,* the line-divisions for each behavior-gram should be not less than three nor more than seven; five seems to be the preferred number. *Fourth,* a rater should not undertake to rate a large number of individuals at one time. The influence of the fatigue-factor is obvious enough. *Fifth,* the raters should be very well acquainted with the individuals to be rated. *Sixth,* the final rating should be determined by averaging the independent ratings, portraying the results in a profile or psychograph.

The psychograph.—The final rating represents a composite of all the individual ratings. In this composite the particular variations of the judges' ratings undergo

modification in the direction of the average trend, much as a jury seeks a "pooling of opinions" in order to reach an impartial verdict. The psychograph, accordingly, reflects the consensus of judgments in definitive portraiture of the particular subject as known to his associates and thereby mirrors his personality. Figure 81 is the profile of a student.

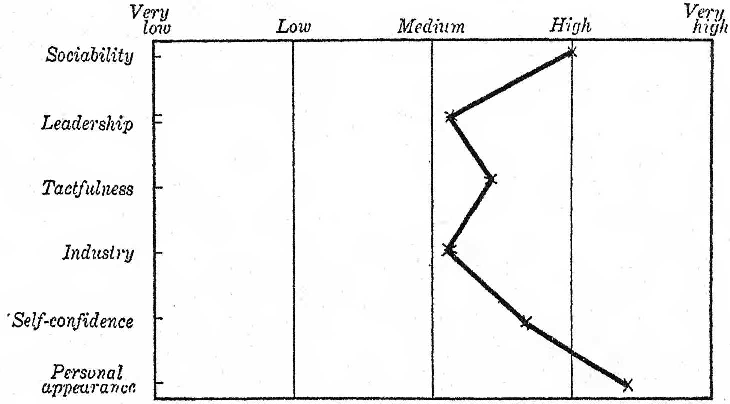


FIG. 81

Profile of Student A, representing the consensus of ten ratings by fraternity brothers.

Despite the relative crudity of the rating-scale method, it has undeniable practical advantages. It does tend rather strongly to inhibit "snap" judgments and meaningless generalizations inasmuch as it guides and focuses judgment along specific lines. And as for the profile or psychograph, its value lies in the convenience and ease of interpretation. One may see by a glance the "assets" and "liabilities" of the particular personality portrayed. Of course, any one profile is restrictive; it portrays the personality in terms only of the traits listed. Hence, if one wishes to know certain other phases of a personality, one must have recourse to appropriate scales.

Questionnaire-inventories.—As a further means of estimating personalities, questionnaire-inventories have

proved to be of significant merit. Mention has already been made of these as a device for determining neurotic trends (Chapter Nine). Here we may note their applicability for eliciting a variety of responses covering many different areas of human interests, capabilities, attitudes, and modes of adjustment.

The principle of the inventory, as a self-rating device, follows upon the assumption that a wide and varied sampling of life-situations, expressed in verbal form, will provide diagnostic clues to patterns of interests and hence to types of adjustment. And since personality manifests itself in modes of adjustment, the particular sampling will presumptively mirror a corresponding phase of personality. Some inventories call for the checking of *Yes, ?, No;* others require the subject to circle *L* (like), *I* (indifferent), or *D* (dislike).

Illustrative situations are the following:

YES ? NO *Do you enjoy social gatherings just to be with people?*

YES ? NO *Do you feel free in a party to offer suggestions for enlivening it?*

YES ? NO *Do you hesitate to volunteer in an open discussion of some interesting topic?*

YES ? NO *At a reception would you take the initiative in meeting strangers?*

YES ? NO *Do you choose to work with others rather than alone?*

YES ? NO *If you came late to a public lecture would you rather stand at the rear than go to the front where there are vacant seats?*

YES ? NO *Do you enjoy the reading of poetry?*

YES ? NO *Would you decline to solicit subscriptions from strangers even though you felt the cause was worthwhile?*

L I D *Examining a collection of antiques.*

L I D *Conversation with clever persons.*

L I D *Discussion with intellectual superiors.*

L I D *Raising money for relief agencies.*

L I D *Initiate conversation with a stranger.*

L I D *Showing others how to play a game.*

L I D *Explaining the operation of a machine.*

L I D *Campaigning in the interest of a friend's candidacy for office.*

L I D *Helping persons to get emotionally adjusted.*

L I D *Preserving an orderly appearance in one's study or workshop.*

L I D *To do uninteresting work for the sake of the good pay.*

L I D *To do work that is interesting despite the relatively low pay.*

L I D *To visit art galleries.*

L I D *To assume the chairmanship of an entertainment committee.*

Not all inventories follow the forms illustrated above. Some require the simple checking of one choice out of five possible types of adjustment to a given situation. Others, again, call for an evaluation of a situation on a scale of intensity of feeling; for example, 1 (like extremely well), 2 (like very well), 3 (like moderately well), 4 (neutral), 5 (dislike slightly), 6 (dislike very much), 7 (dislike very intensely). Indeed, the varieties of forms of inventories, both as to content and method of response, are virtually legion.

Reliability and validity.—For those inventories similar in form to rating scales the method of determining reliability and validity would be similar, too. For other

forms, reliability may be determined by internal consistency of the particular inventory as well as by consistency of scores on repeated use by the same persons. When thus tested, many inventories are found to have coefficients of reliability as high as the best intelligence tests, a circumstance worthy of special note.

In regard to validity, the items of a scale can be diagnostic only to the extent of according with the judgments of experts or with objective criteria. Results from the use of inventories designed to reveal neurotic trends are considered valid if they agree with those obtained by accepted psychiatric techniques. Results obtained on inventories for vocational guidance should accord with objective indices of success on the part of persons already in the respective vocations. Aside from these criteria, the determination of validity is rather uncertain.

The above brief survey of the methods currently adopted for delineating personality patterns suggests the feasibility of the scientific (statistical) approach to the problem of personality viewed, theoretically and practically, as a program concerned with the investigation of types.

THE PROBLEM OF PERSONALITY TYPES

This problem will become markedly clarified upon one's recalling the somewhat analogous problem of types of intelligence (Chapter Five). By correlating the scores obtained on many diverse tests, it was found that abilities tend to arrange in clusters: verbal, arithmetical, mechanical, and so on. On the one hand, the very slight positive coefficients between scores on mechanical ability tests and scores on general intelligence tests indicate a very high degree of differentiation between mechanical ability and general intelligence. On the other hand, the almost perfect positive coefficients between scores on vocabulary tests and scores on miscellaneous verbal tests

point to a very high degree of similarity among verbal abilities. The same is true of arithmetical abilities.

Consequently, one may rightly refer to *constellations of abilities* as a basis for predicting types of aptitude. Admittedly, only a beginning has been made in the discovery of these constellations; but this beginning augurs well for the eventual determination of a number of constellations for each individual that shall serve as an effective basis for counseling along lines of personality development.

One should note, however, that constellations of abilities are discovered by a technique quite different from that for discovering personality traits. Abilities (arithmetic, vocabulary, sense of pitch, and so forth) are precisely ascertainable by standardized tests. Personality traits are but roughly estimated or determined by subjective ratings. Of course, these ratings may approximate objectivity, as we have observed, by the method of consensus. Nevertheless, the difference of technique is fundamental.

The problem at hand, then, concerns the possibility of delineating constellations of traits precursory to classification by personality types. In the following discussion, therefore, we shall include the more important approaches to the solution of the problem as projected by current psychology and as subsumed under three general headings: *psychiatric symptomatology, value-interest,* and *character-responses.*

Psychiatric symptomatology.—Recalling the two main types of psychogenetic insanity—schizophrenia and the manic-depressive psychosis—we observe that they exhibit two broad personality trends or adjustments; respectively, they are seclusiveness, or withdrawal from social interests, and ups and downs of mood, or excitement and depression.

Typical diagnostic symptoms are as follows: for *schizo-*

phrenia, negativism, mutism, stereotyped attitudes and actions, contradictoriness of emotional reactions, and apathy; for the *manic-depressive* (manic phase), flight of ideas, elation, pressure of activity; (depressive phase), slowness of response, difficulty in thinking, anxiety, melancholy or depression. In the depressive phase, a patient may exhibit symptoms characteristic of the schizophrenic, a circumstance sometimes causing doubtful diagnosis. In general, however, schizophrenia is identified by insidiousness of onset, by lack of emotional rapport with environment, and by progressive mental deterioration.

Such are the clinically differentiable types of personality. They are types inasmuch as they exhibit respectively a consistency of reaction-organization to the environment. But they are *psychotic* types; and, paradoxically, they are consistent by virtue of maladjustment.

Now the question may legitimately be asked: Are these types also found, as personality trends, among the non-psychotic or normal? To this question many psychiatrists and psychologists give an affirmative answer. From their observations, the psychotic is simply the end-result of personality trends readily discoverable in normal individuals. In the terminology of Kretschmer (14), the schizophrenic typifies an extreme development of the normal *schizothyme* or seclusive personality; the manic-depressive typifies an extreme development of the normal *cyclothyme* or "open" personality. In the terminology of Jung (12), the one exemplifies an exaggeration of the *introvertive* personality, the other, the *extravertive* personality. Both Kretschmer and Jung have stimulated a profusion of investigations the results of which have evoked a variety of interpretations.

Kretschmer's typology.—According to Kretschmer, the psychotic types are roughly identifiable by body build. Using anthropometric measurements of several hundred

cases in support of his view, he affirms a significant coincidence of diagnostic findings with characteristics of body build. In general, the schizophrenics are tall and slender (leptosome), the manic-depressives are round and plump (pyknic). Other investigators confirm Kretschmer's conclusions (23). Still others obtain no confirmation to speak of (20).

Following the psychotic lead, Kretschmer is of the belief that similar correlations between personality trends and body build obtain among normal individuals. For example, the schizothymes have leptosome bodies and have sensitive but cold personalities; the cyclothymes have pyknic bodies and are alternately gay and sad. Such are the broad characteristics of each type. Each, however, may be divided into sub-classes as follows:

SCHIZOTHYMIC TYPES: (*a*) *The polite sensitive men.*—"They have no moderate tones. They are either sentimentally ecstatic or bitingly cool and abruptly retiring." "In society" they prefer "a carefully chosen circle." "They like to cultivate their own personalities, and observe their own psychic finesse."

(*b*) *The world-hostile idealists.*—"They prefer the abstract, the airy, or lonely nature. In their rare dealings with mankind they suffer from shyness, awkward unskilfulness and stiff formalities; only with a very few old friends are they intimate, where the 'idea' can be discoursed of with warmth and understanding sympathy." They suffer from self-consciousness and the inferiority of insecurity. They express the ascetic's interest in moral rigor and denial of material wealth.

(*c*) *Cold masterful natures and egoists.*—"They are always very correct in their attitudes and have an exaggerated sense of honor." "They find it hard to forgive." "They feel at home in an atmosphere of commands and stiff bureaucratic discipline, but they do not understand how to handle individual men."

(*d*) *The dried and emotionally lamed.*—These lack a sense of humor, manifest very little of the spark of life, are easily thrust into silence, and find refuge in subordination.

Cyclothymic Types.—(*a*) *The gay chatter-box.*—Such persons "swim merrily about over the surface without any ambitions."

(*b*) *The quiet humorists.*—These are the good-natured story-tellers. "They know exactly how to handle men."

(*c*) *The silent good-tempered men.*—They are sympathetic, phlegmatic, cautious individuals whose chief motive is to live at peace with the world.

(*d*) *The happy enjoyers of life.*—These are "easy to get on with in company, sociable, a tendency to portliness, emotional restfulness . . . and behind it all is concealed a certain Philistine quality, satisfaction with the more modest pleasures of life and the most banal topics of conversation." They express neither pathos, idealism, nor high purpose.

(*e*) *The energetic practical man.*—This is the type who is "always sitting on committees, always overburdened with work but enjoys being overburdened. . . . They always like to have a great deal to do, and above all a great many little jobs . . . they speak out their opinion once and for all, and yet are ever in good temper . . . and have a sure comfortable feeling of their own value (15).

When schizothymes become leaders they turn out to be either pure idealists and moralists, despots and fanatics, or cold calculators. When cyclothymes become leaders they turn out to be either "whole-hoggers" and tough, simple fighters, or cheerful organizers on a grand scale, or conciliatory diplomatists (14).

These typological descriptions doubtless carry considerable plausibility. One has only to scan one's associates and to review the noted personalities of history in order

to find ready exemplars for each of Kretschmer's subtypes. Kretschmer, in fact, offers numerous historical cases. His descriptions, however, have more of a literary than of a scientific stamp, despite their psychiatric matrix. Certainly, up to the present, they have received no scientific validation.

Jung's typology.—According to Jung (13), the normal analogue of the schizophrenic is the *introvert,* that of the manic-depressive is the *extravert.* Since this typology has proved somewhat amenable to experimentation and has had considerable influence upon current theorizing in psychology, it merits much more than passing notice.

The outstanding qualities of the introvertive personality may be defined as *reserve, sensitiveness, avoidance of social contacts, autistic thought,* and *radicalism of opinion.* A typical introvert will appear very shy, particularly in the presence of strangers, and suffers from embarrassment if made the center of attention. In a group he is the listener rather than the talker. His reserve is often mistaken by others as a frigidness of soul, but for him it is a device of protection. His sensitivity is really so keen that he develops a cold and forbidding manner simply to avoid being bruised. Underneath this manner there is likely to be a charm and delicacy of feeling which only his most intimate associates become cognizant of. In the midst of company he is solitary. In a crowd he will be found on the periphery. Usually he will avoid the crowd. He prefers his own meditations to the babble of others; hence he usually walks alone, works alone, amuses himself alone.

If the introvert may choose his occupation, he will adopt the kind which tends to free him from dependence upon others; or at least the kind which can be pursued mainly alone; for example, clerical work, individual craftsmanship, writing, and other fine arts, research, and other scholarly pursuits. He is much more the man of

reflection than of action. Accordingly, his interests mirror a philosophical outlook. He surveys life in problematic terms. In passing judgment upon men or events he will be disinclined to blunt his darts of criticism but will shoot them without particular regard for the sensitiveness of other's feelings. For this reason, he is often considered selfish and brutally indifferent to the welfare of others, though he himself will take pride in his forthrightness of opinion. He is prone to be cynical, sarcastic, and sardonic. To him most men are fools, most women shallow. He is thoroughly discontented with the world as it is; takes nothing on authority; and is more apt to disagree than to agree. All this is indicative of an idealistic strain in his make-up, of motivation by remote and intangible goals, and of compensatory cravings.

The outstanding qualities of the *extravertive* personality may be defined in terms quite the contrary to those of the introvert. He is the typical hail-fellow-well-met. Far from having inclinations to withdraw from social contacts, he goes out of his way to make them. In a group or crowd, he gravitates to the center; freely suggests plans for action; and has a naïve penchant for story-telling, particularly along lines of personal exploits. He gives freely of his time to civic enterprises; adopts band-wagon methods of promotion; and aims to be agreeable to all comers.

Although inclined to compromise upon matters in dispute, the extravert tends towards conservatism in social and political affairs. Hence he views "advanced" ideas with distrust. His policy is to take things as they are and make the most of them. He therefore looks upon philosophers and poets as impractical and visionary. If he has any philosophy, it is likely to be of an epicurean sort: life is to enjoy rather than to problemize about. Instead of being cynical, he is jovial. Instead of being scornful, he is generous. His motto is: *Keep smiling.*

The extravert's vocational interests would naturally follow lines of social relationships: business enterprise, managerial activities, politics, salesmanship, showmanship, and the like. He views men and things realistically and believes in giving people "what they want." His goals, for the most part, are immediate and concrete—"things done, that take the eye and have a price." Above all things, the *bona fide* extravert wishes to be in the "swim," to enjoy life in terms of goods, and to take human nature "as it is."

Jung conceives both introversion and extraversion to be divisible into subtypes. Briefly, these subtypes may be seen in characteristic patterns as follows:

INTROVERTIVE TYPES: (*a*) *Introvert thinking.*—A man of this type values ideas for their own sake. He is the philosophical system-builder, exclusively concerned with the thinking process in the endeavor to understand the mystery of things.

(*b*) *Introvert feeling.*—This type is found more often among women than among men. Feeling dominates behavior but at the same time is concealed. When outwardly expressed at all, it takes the form of poetry, piety, and cultism.

(*c*) *Introvert intuitive.*—Here the keynote is "inspiration." The subject is dominated by phantasies and flies from interest to interest as enthusiasm waxes and wanes.

(*d*) *Introvert sensation.*—The artist is mentioned as typifying this introvertive trend. He revels in sensory imagery for the satisfaction it brings him. His creativity, accordingly, is but a device of sensory gratification which leaves the artist living on a plane of illusion.

EXTRAVERT TYPES: (*a*) *Extravert thinking.*—This is the type which lays great store by principles as guides to conduct. He lives according to formulas and tends, therefore, to a rigidity of adjustment which readily passes

over into intolerance. He is a man of convictions, reasoned out, and adopted as a badge of integrity.

(*b*) *Extravert feeling.*—Women represent this type to a greater extent than do men. Action and thought are dominated by impulse. Likes and dislikes appear spontaneously toward persons and objects, and judgments are made accordingly. Logical reflection is almost foreign to this type.

(*c*) *Extravert intuitive.*—Here we find the person who "sees at a flash" the trends of action. He follows hunches and proceeds in great confidence to promote schemes, to give "tips," and to move with agility from one enterprise to another. He sparkles but does not persist. Life for him is a succession of projects and bursts of enthusiasm.

(*d*) *Extravert sensation.*—The exemplar of this trend of personality is the self-satisfied man of the world, the man of epicurean tastes who works and lives for the things which induce feelings of sensory pleasure: food, clothes, amusements, and the conventionally sociable amenities.

It will be seen that Jung's and Kretschmer's typological delineations overlap to a marked degree, a circumstance which lends support to the conception of types of personality. In studying persons empirically one does observe certain broad similarities of attitude and interest and action; but whether or not typology can be founded upon empirical observations alone is a question of moment. Critics have remarked that if one starts out with broad types and then finds it necessary to subdivide each of them, one must logically go on beyond four or five subtypes—really until one reaches a point where typology becomes a misnomer; where, in other words, one comes face to face with nothing but individual differences.

Experimental evidence.—To settle the problem as to the reality of such types as have been described, the only

recourse is to experiment. For it would appear reasonable to suppose that practicable tests could be devised to discriminate the types if the latter are factual rather than conjectural. This has been done.

Some of the inventories mentioned earlier in the present chapter, as well as in Chapter Nine, are composed of behavior-grams which purport to be discriminative of attitudes typical of schizothymic-cyclothymic or introvertive-extravertive trends. For the most part, this kind of inventory requires the subject to check or underscore those items which directly express his own feelings and interests. His score is then determined by norms established in the standardizing of the scale.

How *reliable* these inventories are may readily be ascertained by statistical means. Suffice to say, a number of inventories express a fair degree of reliability (5, 24). Of course, no inventory is fool-proof. Self-objectivity and utter frankness such as the inventories presuppose are, to say the least, not the commonest of virtues. In view of tendencies toward rationalization, not to mention occasional duplicity, errors are bound to creep in. By and large, however, these errors are not of so great a magnitude as to render the inventories and scales worthless; quite the contrary. Experience shows that when questions and behavior-grams are expertly formulated and when subjects are serious-minded in checking themselves, the results are uniformly dependable.

How *valid* the scales are may be determined by correlating the results with clinical or other evidence. If, on administering a scale to psychotic or psychopathic individuals already diagnosed as type-cases according to psychiatric examination, the schizophrenics and schizothymes test introvertive and the manic-depressives and cyclothymes test extravertive, then the particular scale is valid as a discriminative instrument. A number of scales have been thus validated (4, 18).

Now the question may appropriately be asked: What results are obtained from applying such scales to normal individuals? And this question may be answered by reference to frequency distribution of scores obtained with normal persons. Table XXV is typical of the best scales.

TABLE XXV. [After Heidbreder (10)]

Class Interval		*Frequency*
20	24	1
15	19	7
10	14	14
5	9	31
0	4 *	62
—1	—5	70
—6	—10	108
—11	—15	85
—16	—20	106
—21	—25	66
—26	—30	35
—31	—35	9
—36	—40	5
—41	—45	1
		600

* *Positive scores indicate trends toward introversion.*

This table clearly shows how individuals of the normal population arrange in terms of alleged types. Most cases are neither introvertive nor extravertive to any noticeable degree. For them the term *ambivertive* has been coined, indicating that the average person is a composite of both introvertive and extravertive trends in balancing degree.

A survey of available experimental data points to the conclusion that with relatively few exceptions individuals do not fall into well-defined types as Jung and Kretschmer suppose. Most individuals react now introvertively now extravertively as the particular mood or circumstance arises in daily life. But the experimental

evidence does not lead to the inference that exceptions should be ignored, or treated as non-existent. They may be comparatively few but they are real nonetheless. As Kretschmer pertinently remarks, it would be quite illogical to argue from the observation that among a group of sweet peas there were twice as many pinks as reds and whites that the reds and whites could not be at all (16).

So far as an introvertive or extravertive constellation of traits is concerned, such applies to a statistically rare few and to a rather narrowly restricted group of interests. Scale-items which do have significant diagnostic value are those pertaining to reactions to the social environment (6). They are significant because responses to them are consistent, both for introverts and for extraverts. In general, then, a person is introvertive in so far as he expresses the following: a fear of or tendency to shrink from those situations which demand free social access and adjustment, a marked sensitivity to the attitudes and opinions of others leading to avoidance of miscellaneous social contacts, and a noticeable tendency toward absorption in self. A person who expresses the opposite tendencies to a marked degree is extravertive.

Value-interests.—Commonality of interests and values provides another basis for discovering types. Accordingly, Spranger (21) proposes a sixfold classification: *theoretical, economic, esthetic, social, political,* and *religious.* Each of these he has determined from empirical observations upon types of vocational choice, attitudes toward the problems of life, and values placed upon social, material, and cultural incidents and effects. This approach to the problem is *a priori* and empirical rather than experimental. Nevertheless, it is an approach which appears susceptible of experimental attack.

For the moment, however, it would be well to outline

the differential factors which Spranger takes as indices of the respective types.

The theoretical type.—He is best exemplified in the metaphysician and pure scientist. He looks upon the world in a wholly objective or impersonal manner. His motive is to pursue truth wheresoever it may lead; and truth for him is a matter of pure reason. So absorbed is he in this quest for truth that he remains rather oblivious to social demands and civic enterprises and even neglects many of the ordinary necessities of life. He is a favorite subject for caricature as the impractical idealist.

The economic type.—This type prefers utility to all else. His values are external—goods, practical achievements, profits. He seeks power in terms of wealth, gauges people according to their earning capacity, and puts primary emphasis upon thrift and industry. He is the typical business man, hard-headed, unsentimental, "business is business" sort of person. If he becomes interested in art or social welfare he does so with an eye to "returns."

The esthetic type.—The artist is the exemplar of this type. Life is an opportunity for sensuous gratification. Form, harmony, proportion of things seen and heard dominate his reactions. He dislikes the conventional and the economic and hence tends towards eccentricity and impecunious living. Paradoxically, the real world to him is the world of illusion. He resents any form of regimentation; prefers rather to be a free lance, socially, ethically, and economically.

The social type.—A person of this type is strongly motivated by an interest in his fellow-beings. Accordingly, he will be found in the forefront of social movements, particularly those fundamentally philanthropic in character. His is the religion of service, performed without thought of self-interest or profit. He finds happiness in doing good.

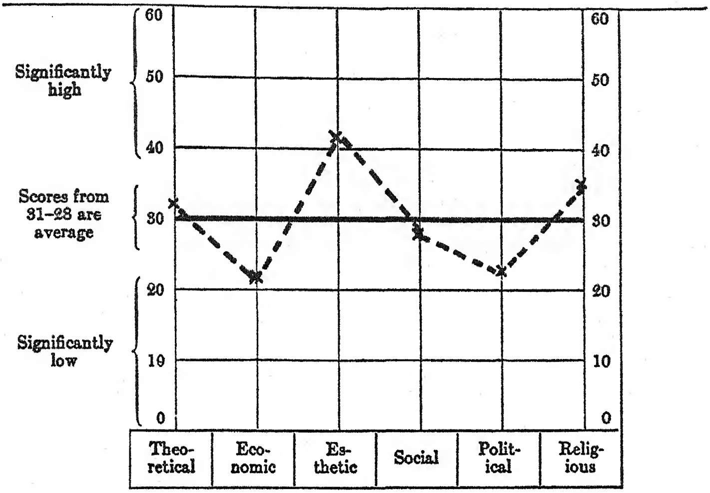
The political type.—The motive in life for this type is *power over others.* He views men realistically, believes in taking them as they are, that is, as pawns in the hands of those who appear to have something to offer—bribes, preferment, influence. He is essentially a manipulator and hence is not concerned over scruples. He is ever ready to "fix" things—to be sure, with an eye to his own opportunities. One of his frequent boasts is his freedom from illusions and impractical motives.

The religious type.—Under this are two subtypes: the mystical or pietistic person whose primary motive is ecstatic contemplation and the salvation of his own soul; and the social or missionary type who saves himself by concentrating on the salvation of others. The former expresses humility and reverence, the latter, a philanthropic zeal which leads to all kinds of self-sacrifice for "the cause."

This classificatory scheme has been subjected to experimental investigation under the leadership of Allport and Vernon (1, 2). These investigators constructed a scale embodying typical situations of daily life and formulated in such a manner as to elicit judgments expressive of an evaluative attitude. Here are two samples:

> If you had to spend some time in a waiting room, and there were only two magazines to choose from, would you prefer: (*a*) *The Scientific American;* (*b*) *Arts and Decoration?*
>
> If you were given certain topics on which to write an essay, would you choose: (*a*) *the rôle of church-going in religion,* or (*b*) *the defects of our present educational systems?*

Figure 82 presents the profile obtained from an averaging of the scores of seventeen college teachers of languages and literature.



Profile of values—Seventeen college teachers of languages and literature

Percentile	Scores on any value	Percentile	Scores on any value
5 (low)	0–16	60	30–31
10	17–19	70	32–34
20	20–23	80	35–36
30	24–25	90	37–40
40	26–27	95	41–43
50	28–30	100 (high)	44–60

Norms for adults and undergraduates (both sexes)

Fig. 82
[Norms are from Allport and Vernon (2)]

Table XXVI presents data from diverse groups as indicated.

TABLE XXVI.—Value-Interest Scores of Typical Groups [After Allport and Vernon (2)]

	Theoretical	Economic	Esthetic	Social	Political	Religious
463 male college students and adults (unselected)	*31.49*	*31.28*	27.61	29.68	*31.88*	28.07
313 female college students and adults (unselected)	28.04	28.72	*32.47*	*31.42*	28.00	*31.37*
Selected groups of male subjects:						
10 psychologists	*44.5*	23.1	*37.0*	31.0	22.4	22.0
26 students of science and medicine	*34.3*	28.5	28.6	29.4	33.4	25.8
64 students in engineering	*32.0*	*35.1*	26.1	29.0	31.4	26.4
43 students of economics and business	29.6	*36.5*	26.9	29.1	*33.2*	24.8
14 students of language and literature	28.8	27.0	*39.6*	27.2	29.2	28.2
18 students of law and politics	27.6	29.2	25.0	30.3	*36.5*	31.4
13 students for the ministry	25.7	22.3	23.3	*33.5*	26.0	*49.2*
17 business men in Catholic club	26.8	*32.6*	21.2	28.1	*33.8*	*37.5*
26 boy scout leaders	31.6	*32.6*	21.5	*32.3*	28.5	*33.5*

Experience with this type of scale tends strongly to confirm Spranger's view that value-interests are significantly diagnostic of personality types. Whether his precise classification will stand up under thorough testing is a matter for future determination. At present, one can only conclude that it offers fruitful possibilities. At all events, the types are not to be construed as a pigeonholing affair. A given personality, as Spranger himself maintains, is always a composite of trends. The dominant issue turns on whether or not one or more types of interest stand out conspicuously above the rest. If and when conclusive data are forthcoming in validation of the scale (or some new one), then a profile such as the above will be of great practical value as additional material for the program of psychological counseling.

Character responses.—The term character is here used to designate that aspect of personality usually defined as *moral conduct.* As such, it has come under experimental study through rating scales, questionnaires, and tests of performance. Of all the studies made in recent years, the one comprised under the *Character Education Inquiry* (CEI) is the most extensive (7, 8, 9).

In this inquiry, the experimenters devised a battery of tests covering situations involving cheating, stealing, and lying, from the standpoints both of actual performance in and knowledge about appropriate situations. The upshot of the study is that *low positive correlations are found between tests of conduct and tests of moral knowledge.* In other words, there is no significant relationship between what children *know about* right and wrong and what they *actually do* in situations where opportunity is given to cheat, steal, or lie.

Moreover, there is no statistical evidence to support any view which presupposes general traits of character such as honesty, generosity, or the reverse. Children prove to be honest or dishonest according to their conception of the demands of the particular situation. In fact, it is the variability of the situations which elicits variability of response. The resultant low, though positive, correlations therefore provide no basis for predicting consistency of behavior from one situation to another. To be sure, the correlations are positive and thus indicate a tendency towards consistency, but a tendency all too slight.

CONCLUSIONS AND SUMMARY

In this chapter, we have described and evaluated representative scales formulated as psychological instruments for disclosing personality trends and types. The problem of types was approached through a consideration of the analogous problem of types of intelligence. But this

analogy was seen to be of service only in suggesting the necessity for statistical methods in the attack on the personality problem. So far as intelligence is concerned, we find substantial statistical evidence that certain abilities correlate so highly as to warrant the conclusion that types do exist—arithmetical, mechanical, verbal, and so forth. When, however, we undertake a similar procedure with personality traits, we are somewhat confounded at the outset by the problem as to what a trait really is. For it is quite inadmissible to assume that traits—coöperativeness, integrity, generosity, and so on—exist and that they are just waiting to be measured. Fortunately, we can escape this difficulty by abandoning the use of abstract terms and by substituting behavior-grams which call for a specific response to a specific situation. What, then, do we discover by the use of scales of behavior-grams?

In the first place, we discover that they successfully select individuals who, for purposes of simple designation, are called introvertive and extravertive. But we are justified in calling them such only to the extent that they fall towards the extremes of a frequency distribution derived from scores on scale-items involving social attitudes and behavior. With psychotics the results are quite different. Psychotics tend to show a consistency of behavior regardless of situations. The normal, on the other hand, adapts himself to the situation. He is *ambivertive* in the sense that he expresses both introversion and extraversion on occasion. This, however, is tantamount to a denial of types so far as most persons are concerned.

In the second place, we discover not some all-inclusive pattern of traits but rather individual differences, both in a group and in the same individual from situation to situation. That some consistency is present is evidenced by positive correlations, even though they are low. Sta-

tistically, the variables in human behavior are so many and so complicated that no basis for pigeon-holing can be obtained in any rigid sense. These variables, one may say, are the effect of a complex environment reacting differently upon different individuals and upon the same individual at different times.

From the above considerations, one should not infer that henceforth all investigations upon the problem of types are altogether futile. Since the problem is essentially a statistical one of determining correlations, it may be that further refinement of methods of attack will reveal larger and larger patterns of behavior trends as basic categories of personality. At any rate, the present scales are eminently useful as material for the construction of profiles—intelligence, emotionality, value-interests, vocational aptitudes, and so forth. These profiles will reveal the person to himself as an organization of adjustment towards those life situations sampled in the scales and others that are highly correlated with them.

The statistical method is the scientific method by which personality may be delineated. Any scheme of interpretation, therefore, which purports to classify individuals under any rubric whatsoever must be evaluated by this method. Popular systems of character analysis such as astrology, phrenology, physiognomy, and graphology fail completely to meet the tests of science. Their classifications and portrayals, plausible as they may be to naïve understanding, have no basis in fact. All statistical investigations of such classifications lead to one conclusion, namely, that the alleged relationships are utterly spurious (25).

THE CULTIVATION OF PERSONALITY

Viewed as a practical program, the cultivation of personality may be surveyed from two approaches—genetic

development and adult self-modification. On the one hand, cultivation begins at birth, or shortly afterwards; on the other hand, cultivation presents a problem of self-analysis and self-correction of a personality already established.

The genetic approach may be seen to best advantage in the programs of nursery-school education. In the Yale Psycho-Education Clinic, the Iowa Child Welfare Station, the Minnesota Child Welfare Station, and similar agencies, the program of building personality provides for the utilization of psychological techniques by which socially desirable traits may be developed and socially undesirable traits inhibited and prevented. Such a program is indeed ambitious. If successful, it will doubtless provoke a social enterprise of child-training that will be of immense importance for human welfare. The program, however, is of but recent undertaking and expresses a hope rather than an achievement.

Moreover, a program of child-training is not only in the pioneer stage of development but is also befuddled by the clamor of contradictory theoretical assumptions. We find hereditarians discounting environment, environmentalists discounting heredity. And between these we find those who, granting an hereditary *basis* (genes) for personality, are nevertheless convinced that environment can, in many respects, mold the personality despite the genes.

In a textbook such as this, we cannot go into the merits of the opposing assumptions. However, in view of the practical aspect of the problem of training, some consideration of the merits should be undertaken—at least of major points.

In the first place, an exclusive concern with genetic studies is apt to lead to an overemphasis of hereditary factors. From discoveries of the precise genetic basis for *anatomical* traits, one is not entitled to infer a precise

genetic basis for *personality* traits. Eye color, hair texture, and the like are indeed effects of genetic constitution; but generosity, sense of humor, leadership ability, and the like are by no means analogous effects of genetic constitution.

Nor do the discoveries of *endocrinology* respecting the glandular determinants of behavior warrant the extraordinary inference that personalities are classifiable into *thyroid, adrenal, pituitary, gonad,* and other "types" (3). That overactive adrenals are *a* causal factor in excitability is now fully established; but that they are also *the* causal agent in traits of initiative and optimism is an inference highly disputable. However important the glands are, they do not determine personality independently of social conditions. A cretin may become a prostitute but not simply *because* she is a cretin (19). An old man may become a pessimist but not *because* of gonadal cessation.

Undoubtedly, the sciences of genetics and endocrinology have disclosed a significant body of data respecting anatomical and physiological conditions of behavior. At the same time, the relation of these conditions to personality traits is utterly obscure. Hence the data at hand can scarcely be utilized to support an exclusively hereditarian interpretation of human behavior. No one knows what sheer heredity would accomplish in the determination of personality or behavior. Even the few cases of "wild" children that have been discovered—for example, the "wolf children" of India and the "wild" boy of Aveyron (22, 11)—provide no clear evidence of heredity unmodified by environment.

In the second place, to lay emphasis upon environmental factors, as though these were singular determinants of personality traits—the genes notwithstanding—is to overload interpretation at the opposite extreme. Yet the behavioristic thesis, as expounded by Watson, is that

personality is "but the end product of our habit systems" (26). According to this thesis, our habit systems have been built by a process of conditioning reflexes from birth onwards. How this process occurs, in terms of connecting a stimulus with a response, was described in an earlier chapter. For the behaviorist, heredity determines the *structural* aspects of the organism—the "general architectural plan"—but the environment molds them into habit reactions.

Aside, then, from structural defects, the behaviorist "would feel perfectly confident in the ultimately favorable outcome of the careful upbringing of a *healthy, well-formed baby* born of a long line of crooks, murderers, thieves, and prostitutes" (27). So confident is the behaviorist that a personality is the product of specific conditioning, he is willing to proclaim: "Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I'll guarantee to take any one at random and train him to become any type of specialist I might select—doctor, lawyer, artist, merchant-chief, and, yes, even beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors" (28).

Thus, the behavioristic program lays emphasis to almost the *nth* degree upon environmental determination of personality. Personalities can be made to order. All a parent needs to do is to prescribe in advance of his offspring's birth the particular personality he wishes to form and then follow the behavioristic blueprint. The only qualification is that the offspring must be organically sound. As Watson puts the matter: "If you decide that the human organism should behave in this way, you must arrange situations of such and such kinds" (29). And further, if one desires to change one's personality later in life (up to the age of thirty) one's procedure

would be to displace the undesirable habits by establishing new habits through change of environment (30).

This program of conditioning, however, is confessedly speculative (31). Altogether too scanty data are available to lend it support. And these data are by no means unambiguous (17). No individual has been studied for any significant length of time to afford any clue as to the effectiveness of methods of conditioning personality. Until the infants now under process of laboratory conditioning have grown at least to adolescence, no substantial and crucial data will be available either to affirm or to deny the behavioristic claims.

Theoretically and practically, neither the extreme of hereditarianism nor that of environmentalism adequately provides for the cultivation of personality. The one is productive of fatalistic implications and would therefore tend to neglect possibilities of environmental stimulation. To be concerned about genes and glands to the neglect of other conditions is to court failure at the outset. For personality traits are not biological entities but social concepts. The other is similarly fatalistic in assuming that the individual is a sort of putty malleable by stimuli and determined as to personality pattern by conditions wholly beyond his control. This is the *robot* conception of human nature and one that appears plausible until closely examined.

When brought under logical scrutiny, both extremes are seen to be self-refuting. Both appeal to society to undertake a scientific program of improvement. The one seeks to improve personality by eugenic control, the other, by conditioning reflexes. Either appeal implies individual initiative and insight and so implies a denial of fatalism; for either involves the assumption that the individual (or the individuals composing society) can envisage the problem and task of cultivating personality. Indeed, without this assumption the very problem itself

could not arise. Genes do not improve themselves. Robots cannot look at themselves and find themselves lacking some quality necessary to success in dealing with other robots.

Wherefore, in conclusion, we may now see the significance of personality inventories. They supply the data one needs to have in order to undertake the task of personality cultivation. By them and through them one is mirrored as a personality—a personality estimated and evaluated through social relationships.

Whether or not one will undertake to correct the liabilities thus revealed or to capitalize on the assets is another matter. Obviously, the first step is frank acceptance of the probable truth of the revelation. The second step is the willingness to undertake the necessary modifications as a program of self-cultivation directed under expert advice towards an attainable and satisfying goal.

QUESTIONS FOR DISCUSSION

1. What reasons might one advance for psychology's apparent avoidance hitherto of the problem of personality?
2. What examples could you mention of the mutability of habit?
3. Describe the method of the rating-scale. What are its advantages and disadvantages?
4. Describe the method of the inventory. What are its advantages and disadvantages?
5. Give the gist of the different approaches to the problem of personality types. Which of these approaches impresses you as the most practicable? Why?
6. Would you attribute any significance to the circumstance that Kretschmer's and Jung's typologies had been anticipated long ago in drama and caricature? Elucidate.
7. What cases could you cite for each of Spranger's types? Would you say that such cases suggest types or trends? Why?
8. What inferences would you draw from the results of the CEI?
9. How would you proceed to test the validity of any scheme of personality classification? Consider, for example, phrenology, physiognomy, graphology, and the like.
10. What, precisely, is involved in the cultivation of personality?

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